FLIGHT
and The AIRCRAFT ENGINEER

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The Outlook

Civil Aviation Again

LAST week we referred briefly to the plight in which civil aviation, and more particularly commercial aviation, finds itself owing to the preoccupation of everyone concerned with the more urgent demands made upon their time and efforts by the war. This applies to Government departments and to aircraft constructors alike. The only people who have time to worry about commercial aviation are the operating concerns, who will, sooner or later, be faced with the problem of getting replacement aircraft.

There is not, in the Air Ministry, anyone with special interest in commercial aviation and with sufficient strength of will to make himself heard amid the clamour for military aircraft and equipment. It would need another Sefton Brancker to do that. It would need a man who was not afraid to make himself a confounded nuisance if by so doing he could obtain a square deal for commercial aviation.

That war requirements must come first is obvious. But those in authority at Westminster are always very busy with references to the wonderful new world we are going to create when we have won the war. Do not let us forget that, after the war 1914-18 it became a trite saying that the Allies had won the war, but Germany had won the peace. It is not altogether unthinkable that, if we fail to look further than the signing of the peace treaty, we may be in no shape to create anything worth while at the end of this war. "Keeping the home fires burning" and "Business at usual" are all very well as slogans, but unfortunately slogans will not suffice. They must be translated into action.

In the meantime, the members of the Air Council are, quite properly, devoting all their energies to the prosecution of the war in the air. To them commercial aviation must of necessity be a subject of relatively small importance—more a nuisance than anything else, in fact. Sir Kingsley Wood finds time to do an amazing amount of work. That he eats and sleeps with his job is literally true. But he has more than sufficient to do as it is, and he can hardly be expected to spare time for looking deeply into the details of the needs of commercial aviation.

A Different Policy Wanted

WHAT is needed, and what the Civil Aviation Development Committee to which we referred last week should look into, is the possibility of getting some of our designers to work on types which, while capable of giving useful war service, shall be primarily designed for post-war commercial work. We all know that commercial aircraft can be converted into serviceable military machines.

The De Havilland *Flamingo* is an example of a commercial aeroplane which can be, and has been, transformed into a troop transport. There seems to be a tendency to think that some of our existing bomber types might, when the war ends, be converted into commercial machines. That belief is fundamentally wrong, and if that policy were followed we should merely have a modern equivalent of the "commercial" aeroplanes of 1919-20, D.H. 4s and 9s with a "lid" over the cockpit, which did the earliest commercial flying after the last war.

We suggest that this time the procedure should be reversed; a start should be made with designing the most efficient commercial aircraft possible, and then the necessary changes should be made to turn it into a usable military type.

That there are difficulties in the way is obvious to everyone, but it should be the task of the committee to find ways and means to overcome them. Not the least is that of deciding upon the type of machine which may be expected to be in demand after the war. Here the Directorate of Civil Aviation can assist by obtaining the views of operators throughout the Empire. It is almost certain that two, or possibly three, different types or classes will be wanted if all needs are to be fulfilled. But operators in collaboration with designers should be able to get out reasonable specifications.

The Onslaught on Shipping

WE have noted before the sound strategical sense which has induced the Germans to concentrate their air efforts, such as they have been, on attempts to damage the naval and marine power of Britain. The three days of violent attacks on British and neutral shipping in the North Sea last week have obviously been part of the programme, and the machine-gunning of non-naval seamen can only have been carried out with the idea of terrorising.

Sad experience has taught us that no considerations of international law, of plighted words, or of common humanity will restrain the Germans from a step which they think or hope will go towards achieving their purpose. We have learnt the German mentality. The Germans, on the other hand, have not grasped the spirit of British seamen, and it is only fair to add that they have likewise not realised the tough courage of the merchant sailors of the Scandinavian countries and of Denmark and Holland. These sailors will not be frightened off the seas.

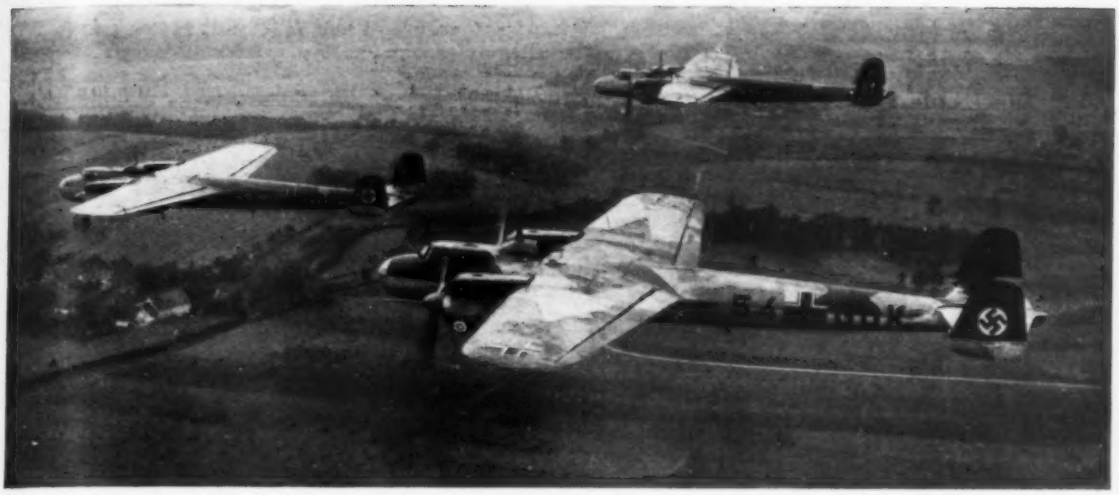
What is hard to understand in the Germans' use of their aircraft is the small numbers which they use for any given purpose. On each of the days of the onslaughts we counted about twenty raiders a day. Considering the size attributed to the *Luftwaffe* before the outbreak of war, those numbers are tiny. The risk to the crews was not very great, as the cloud-covered sky gave plenty of cover. The raiders sent were none of them able to dispute with our fighters when the latter made contact, for Germany is certainly short of types which can both cover the distance and put up a fight.

Help for the Finns

IT would not be in the least surprising if some un-friends of this country, perhaps Lord Hee-Haw, made some jeering remarks about the sending of Gladiators to the help of the Finns. It would be quite in character if that remarkable commentator were to throw out suggestions that the British will only give the Finns second-best machines, but will not spare them Hurricanes or Spitfires. We would anticipate such criticism by pointing out that the Gladiator is the finest biplane fighter ever produced, and is unsurpassed in manœuvrability. The batch sent to Finland had been earmarked for the Union of South Africa, a Dominion which certainly does not wish to invest in second-best stuff. We are ourselves using Gladiator fighters in the war, and instances could be quoted (only we must not tell the British public what the German authorities already know) of German machines having turned and run for their lives when threatened by Gladiators. Certainly in the hands of good pilots, such as Finland can undoubtedly supply, some of them having done periods of training with our Royal Air Force, the Gladiators will be quite good enough to master the bombers which Russia is sending against that martyred country. The fact that their engines are air-cooled will tend to reduce troubles with freezing.

As for the Blenheims, they are the best bombers of their class, and we are using them extensively ourselves. Already, it is understood, they have done useful damage to some of the Russian air bases. We hope they will continue the good work, and will be helped by more bombers from other friendly countries.

OUT LOOKING FOR TROUBLE: Fighter Blenheims in a hurry over the English countryside. Our readers will appreciate that this picture was taken some time ago.



A sight hundreds of R.A.F. fighter pilots would give their boots to see : a flight of Dornier Do. 17s. From this angle the gunners would be unable to fire accurately due to the force of the airstream on their manually-trained guns, and in any case the loop aerials appear to get in the way.

WAR in the AIR

Repeated Attacks on Shipping : Fighting in France and Finland

THE Luftwaffe's mass attack on British shipping, which, as reported in our last issue, began on Monday, January 29, was repeated on the next day. In the two days it now appears that four British ships were sunk by bombs. These were the *Bancrest*, 4,450 tons, sunk off the Scottish coast with the loss of one life ; the *Stanburn*, 2,881 tons, off the Yorkshire coast with the loss of 26 lives ; the *Giralda*, 2,178 tons, off the Orkneys with the loss of all hands ; and the *Highwave*, 1,178 tons, whose crew of 18 was rescued by a Dutch steamer. The *Highwave* was at anchor, but several bombs (one account says 20) were dropped before she was hit. The aeroplane which sank her is described in a Dutch newspaper as a four-motor type, most probably of the Ha 140 class. Actually the Ha 140 is a twin-engined type ; the Dutch correspondent was probably thinking of the trans-Atlantic Ha 139. Other ships were damaged and had casualties without becoming total losses. Some others had narrow escapes. The time during which the attacks were made on Monday, January 29, extended from shortly after 9 a.m. till nearly midday. In spite of severe weather conditions and poor visibility, R.A.F. Fighter Command aircraft were able to engage and drive off the enemy at many points. In the Tyneside area, anti-aircraft guns were also in action. As a precaution, air-raid warnings were sounded in several north-east coast districts. One raider is reported to have dropped seven bombs near the steamer *Llan Wern* in the Tyneside area without securing a hit. Another enemy aircraft attacked the *Imperial Monarch* off the Scottish coast, but fled towards the clouds as soon as British fighters were sighted. Two fighters fired at the raider at long range before he disappeared. Off Tyneside, a Heinkel bomber came out of the clouds and the pilot found himself flying straight into a section of British fighters. When he saw his danger he climbed steeply into the clouds and made off, but not before the fighters had opened fire. Farther south, fighters attacked a Heinkel which fled east into low-lying clouds, firing his rear gun. One fighter was struck by a single bullet, but no damage was done. Other enemy raiders were driven away by fighters while attacking ships off the Yorkshire coast. Two of the vessels attacked by the raiders were defenceless lightships. Later in the morning, enemy aircraft raided ships off the Kentish coast. Ships which reported attacks were the *Miriam*, *British Officer*, *Athol Monarch* and *Dan-y-Bryn*, *Otterpool*, *Knitsley* and *Wellpark*. It is estimated that about twenty German machines took part in the raids of the Monday.

On the Tuesday the Germans came again, and again the weather helped them, for with so much cloud about it was easy for the bombers to escape into cover when British fighters appeared. However, on the Tuesday our fighters had better fortune and took some toll of the raiders.

A recent picture from France with camouflage netting as a foreground and a Blenheim IV reconnaissance bomber as a background.

Above is one of France's new Breguet 690 light bomber-ground attack aircraft. The engines are Gnôme Rhone 14Ns.

The Curtiss Hawk 75A of *l'Armée de l'Air* on the right is being groomed prior to a search for Messerschmitts. These Curtisses are extremely popular.

But from Aberdeen to the Kentish coast, Fighter Command patrols were ready to drive off German raiders, no fewer than twenty of whom flew in towards the coast looking for unarmed British and neutral merchant ships. A number of merchant vessels and a lightship were attacked. Some of these vessels were in convoy and their naval escorts drove off the enemy with anti-aircraft fire. From a North of England Fighter Station, two pilots went up at midday and, in spite of poor visibility, brought down a Heinkel bomber which had been trying to destroy a helpless fishing boat. The two pilots were a Flight Lieutenant and a Sergeant. They sighted two Heinkels five miles off the Northumbrian coast and chased them a further five miles away from their intended victim. The enemy tried to escape by flying low over the water, but the fighter pilots attacked again and again. The Flight Lieutenant said: "I saw one Heinkel dive into the sea and break up."

Almost at the same time another Heinkel was intercepted by fighters off the Firth of Forth as it was trying to bomb a merchant ship. One of the fighters fired a burst of bullets and put the German rear gunner out of action before the Heinkel dived into cloud. The Germans, it is believed, have been giving their gunners some armour protection. This must reduce the bomb load, and is not always effective.

The fact that a German machine escapes into the cover of clouds after receiving a burst of fire from eight machine guns does not necessarily mean that it gets back safely to Germany with its crew, or the survivors of them. For instance, on January 19 a Heinkel was engaged by British fighters off the coast of Aberdeenshire and disappeared into the clouds. About ten days later the bodies of two German airmen were washed ashore at Rattray Head, and these were almost certainly the crew of that particular machine.

A U-boat Sunk

THE Navy and Air Force combined once again with the happiest results on January 30. For a good time past, ships in British convoy have been religiously left alone by German submarines, but on that morning a daring U-boat commander decided to risk his life. He sank the British steamer *Vaclite*, 5,026 tons, owned by the Standard Transportation Co., Ltd., of Hong Kong, which for many months past had been plying to and fro between Great Britain and the United States carrying lubricating oil. While an Italian ship picked up the crew of the *Vaclite* the naval escort dashed to the spot where the U-boat had been seen and dropped depth charges. After a while contact was lost, but the charges had had their effect. Later in the day a flying boat of the Coastal Command joined the convoy and scoured the seas round about. Presently, through a gap in the clouds the airmen caught sight of the U-boat on the surface. She had been damaged by the depth charges and could not remain below the surface. A heavy bomb was dropped on the starboard side of the submarine. Men were observed on deck, and the submarine opened fire with its anti-aircraft gun, the aircraft retaliating with machine-gun fire. Cloud was now down to sea level and temporarily obscured the submarine. The flying boat thereupon proceeded to the warships and informed them of the position of the submarine, but when they arrived the submarine had sunk. Some survivors were sighted in a rubber dinghy and were rescued, and some additional survivors were also picked up later from the sea by British warships.

Auxiliaries in France

IT has now been announced that squadrons of the Auxiliary Air Force are serving in France, men from Surrey and Durham being specially mentioned. Normally the task of most of the Auxiliary squadrons is the air defence of this country, but a certain number of Auxiliaries were given a chance to volunteer for service overseas, and of those to whom the offer was made 99 per cent. at once volunteered. At present it cannot be foretold what the ruling will be at the end of this war about giving medals to those who fought, or were ready to fight, in defence of this country; but at least those squadrons which have gone overseas have made their claims to medals quite secure.

One imagines that active home defence will also win a medal, perhaps with a special clasp, considering the number of times that our fighter aircraft have taken off from British soil to attack raiders and photographic scouts, and have come under the fire of the enemy. At present we will not venture into the Tom Tiddler's ground of considering whether the men of the balloon squadrons and all the men of the Observer Corps have also deserved war medals. We only hope that the medal committee, when it comes to consider the question, will not make the same mistake as the committee of 1919 and allot the same coloured ribbon to two medals which have quite different significance. We have in mind, of course, the Mons Star and the 1914-1915 Star.

The Prime Minister's Review

MR. CHAMBERLAIN made another speech on the war on Wednesday, January 31, not in the House of Commons, but at a luncheon of the National Defence Public Interest Committee. The passage of his speech which dealt with the Air Force was as follows:—

AIR (CONTINUED)

The Westland Lysander army co-operation machine was built to rough it. Here is one in France operating under chilly conditions.

"Now let me turn to the Air Force. I dare say many of you have made guesses at the rate at which our Air Force is expanding. I am not going to give you any figures of that expansion by which you can check your guesses, for a reason which will be very obvious to you, but I may perhaps tell you that the labour force employed to-day upon aircraft construction and all the various apparatus which has to be prepared for aircraft is seven times what it was in 1935-6, and it is higher to-day than it was at the peak of our output in the last War.

"As for the quality of our machines and of their personnel, our experience up to now has shown that it leaves nothing to be desired, and if I am told that the Germans are probably making improvements in their aircraft to correct the faults which have been disclosed, well, I will content myself by saying that we, too, are not standing still.

"I should like to add a few words about that great Empire training scheme which is going in the future to give us an almost inexhaustible supply of expert pilots, observers, bombers and gunners. For that purpose there will be established in Canada no fewer than 67 training schools. They will have a staff amounting to no fewer than 40,000, and they will be provided with upwards of 80 new or enlarged aerodromes. I venture to say that you could have no more striking demonstration of the power of the Dominions, separated by so many thousands of miles from one another, to canalise and concentrate their forces in order to forge a mighty weapon of war."

The Fighting in Finland

WHILE on land the Finns, as enterprising and skilful as they are brave, continue to repulse the Russian attacks with heavy loss to the Bolsheviks, the invaders have fallen back on still more frightfulness from the air. Their bombing attacks are incessant, and a great deal of material damage has been done to many towns and villages. It is said that there are never fewer than 400 Soviet aircraft ready for use or in use against the Finns. Hospitals clearly marked with the Red Cross seem to be especially favoured targets, and some terribly tragic stories are told of wounded and nurses falling victims. On the whole, however, the civilian casualties have not been heavy.

The Finnish fighter pilots seem to have the upper hand of the Russian bombers, so far as their numbers allow, and they report up to twenty-one Russian machines shot down in one day. They have received a contingent of Gladiators and Blenheims from Great Britain, machines which had been ordered by South Africa but which Gen. Smuts allowed to be diverted to the help of the Finns. No doubt the cost of the gift falls on the United Kingdom, for presumably no charge will be made to Finland. Sweden is also supplying aircraft, and so are other countries. If the Finns can only get enough munitions, and particularly aircraft, and can get them in time, they will be able to prolong their defence; though we wish we could see some prospect of their achieving a complete victory in the end. It is reported that the Russians have been dropping parachutists in Finnish uniform behind the defenders' lines.

Twelve Canadian pilots, rejected by the R.C.A.F. on medical grounds, are sailing to fight for Finland.

We must apologise for a stupid slip of the pen in this column last week. We inadvertently wrote that "masses of German bombers" have been flying over Finland. This should have read "Russian bombers."

Last Saturday's Raiding

AGAIN on the morning of Saturday, February 3, some twenty Heinkel III bombers commenced a series of raids on shipping off the coasts of Britain. This time, however, they did not escape without loss, for, despite the cloudy weather, the machines of the Fighter Command succeeded in getting within range on a number of occasions, with a net result that one bomber was brought down on land five miles from Whitby, another was shot down in the sea off the Tyne, and our pilots reported that three more were so badly damaged that it was improbable that they would regain the Fatherland. The Germans admitted the loss of three machines.

The fighting started soon after 9 a.m. A fighter patrol saw a Heinkel dropping bombs at two merchant ships near the Farne Islands off the coast of Northumberland. The Hurricanes attacked at once, and the Heinkels promptly turned tail without returning their fire and made for the clouds up above. But at least one Hurricane had got its salvo home, and its pilot reported: "As the enemy escaped into the cloud I saw heavy black smoke and bits of metal coming from its starboard engine."

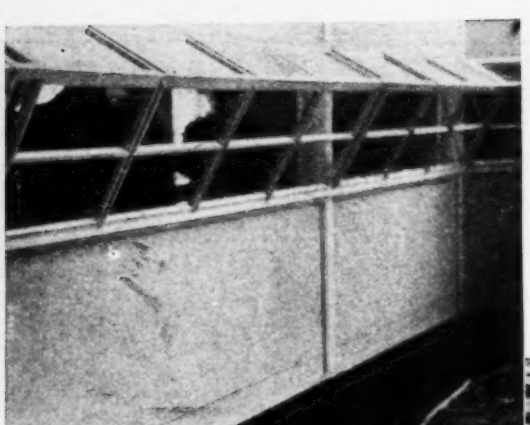
At 9.40 another Heinkel was sighted by a patrol flying low over the sea five miles off Whitby, and heading east. The fighters went for it, and it tried to climb up into the clouds, but the fighters attacked in turn, and, disregarding the fire of the Heinkel's rear gunner, wounded all three members of the crew, and put the starboard engine out of action. The bomber's undercarriage came down, and its pilot turned towards the land. He succeeded in getting there, and made a creditable landing beside a farmhouse near Sneaton Castle. The Heinkel crashed through a hedge and came to rest fifty yards from the house. It brought down telephone wires and cut down a tree. The crew set fire to their machine. They were all wounded, and were taken to a hospital.

Shortly before 11 a.m. another Heinkel was seen attacking ships off the mouth of the Tyne. The attention of a fighter patrol was attracted by seeing the bursts of shells from a gun on one of the ships. One fighter headed the German off from the clouds, while two others attacked him from the rear. The Heinkel came down on the sea at an easy angle, and the crew were picked up by a ship. Other engagements took place, all without damage to any of our fighters or their pilots, and in several cases one of the engines of the bomber was seen to be hit. Only the clouds enabled a number of bombers to escape complete destruction, but when one engine is shot out of action the chances of a machine getting back to Germany through stormy weather must be very much reduced. Two other German airmen were picked up at sea, and the bodies of three more, one wearing the Iron Cross, were washed ashore.

The raiders had attacked over ten ships, and sunk two of them. Eleven seamen lost their lives. A full report had not been published when we went to press.

ANGLO-FRENCH INSPECTION

Delegation of Allied Parliamentary Committee Visits an R.A.F. Army Co-Operation Station



"Flight" photographs.

Indoor aerial. The gallery and large-scale relief map which form the Haskard Target.

DESPITE the recent severe weather conditions a delegation from the Anglo-French Parliamentary Committee of the French Chamber of Deputies recently paid a visit to one of our army co-operation stations to see for themselves how we do these things. It must be remembered that conscription has been in force in France for very many years, and, as a result, every man is somewhat of an expert on military matters. A high standard of efficiency is therefore expected.

The Deputies were received by Air Vice-Marshal N. D. K. MacEwen, who deputised for Sir Hugh Dowding, Air Officer Commanding-in-Chief, Fighter Command, and were treated to a description of the station by the Station Commander. He dealt at length with the origin of the squadrons and, since a large proportion of the personnel were peacetime volunteers, pointed out the many and various trades and professions from which they were recruited. This was followed by a detailed account of the object and the methods used to carry out the work of army co-operation.

There was to have followed a considerable flying programme, but the weather conditions were such that only indoor demonstrations could be arranged. The visitors were conducted over a squadron hangar and inspected in detail the Westland Lysanders which were lined up and looking very smart. The stub wings were fitted showing how the bombs—large and small—were attached as well as supply-dropping parachutes. The Deputies were much intrigued by the ingenious utilisation of space obtained by fitting the machine guns and landing lights in the streamline wheel spats.

From here our friends were taken to the Link trainer

Looking for the laundry. M. L. Bossoutrot (left) and Mr. O. E. Simmonds use a magnifying glass to see details in the R.A.F. photographs of the Siegfried Line.

"Flight" photograph.

Members of the Anglo-French Parliamentary Committee inspecting the bomb racks of the Westland Lysander.

room and shown this means of practising flying during bad weather, and bad-weather flying at any time. Exceptional interest was shown in the Haskard Target, which is a large-scale relief model of a landscape as seen from some 6,000 ft.; on it all the features of army co-operation work can be imitated. Artillery shoots are depicted by tiny flashes of light and puffs of smoke; tanks and transport columns—actuated by magnets—move along the roads, and the whole affair is true to scale. Apparently the French have nothing comparable with this for indoor training and practice.

In the photographic section aerial pictures were on view of the West Wall, Wilhelmshaven and Cuxhaven, in addition to a display of cameras and darkroom equipment. A visit to the parachute section, where the latest parachute equipment was displayed and where a demonstration of the packing of supply-dropping parachutes and containers was given, completed the business side of the inspection. Refreshments were served in the Officers' Mess, and officers of the Women's Auxiliary Air Force, who are now a familiar part of most Royal Air Force stations, were presented to the Deputies.

"SIGNALS"

Use of Telephone, Teleprinter, Wireless, Despatch Rider and Pigeon

"SIGNALS" is one of the most important sections in any Command of the Royal Air Force, for it is essential that messages should always arrive. To provide a service that never fails is a task which taxes the capacity of the officers responsible as much as any duty in the R.A.F. They are all regulars with flying experience.

Messages are sent by telephone, teleprinter, wireless, despatch rider or pigeon. Each of the methods of transmission entails a separate organisation.

The whole of Great Britain is covered with a network of communications by these various means. The signal lines enable the forces of Fighter Command, charged with the air defence of this country, to come instantaneously into action when danger threatens. The network has been pieced together so skilfully, partly before the war and partly since the outbreak, that communication can never be interrupted at a point of importance.

Countless telephone lines link up every R.A.F. station. This is one of the reasons why civilians sometimes experience delay in telephoning.

Certain of the R.A.F. telephone lines are "untappable." Even if a spy "plugged in" on one of these secret lines he would hear only a confused humming.

Wireless is used in every possible way. Radio telephones enable instruction to be given to fighter pilots in the air and their reports to be received. If you could listen-in you might sometimes hear unconventional conversations between pilots in the air.

The teleprinter machines are used for the rapid transmission of written messages or reports. They are typewriters which print the messages at the end of a telephone line as the words are typed at the transmitting station. Instantaneous reception of news is as necessary to the R.A.F. as to newspapers, for which the teleprinter was originally invented.

Certain communications can only be sent by hand. For these despatch riders are used. A number of men are always on duty with their motor cycles at every R.A.F. station. They scour town and countryside at all hours of the day and night on various errands.

The other bearer of despatches by hand is the pigeon. Large numbers of birds have been recruited for service on board the reconnaissance aircraft of Coastal Command. On their long flights over the North Sea and Atlantic these craft often need to send a message ashore. It is not always advisable to use wireless. The pigeon is a reliable if slower substitute. Many of the King's racing pigeons are serving aloft on this duty.

The signals officer is responsible for the transmission of messages by all these methods. He has charge also of the cyphers department. He must see that there is no delay in the secret coded messages that are flashed to and fro day and night.

Some of these officers describe their job as a "humdrum" one. Yet they are occasionally startled. One was talking to a squadron which was taking off on patrol a few days ago when he heard a voice say calmly:—

"I am about to hit the fence."

The signals officer replied: "Did you say you were about to hit the fence?"

The answer came back immediately: "I did. I have now hit the fence."

The young Canadian pilot's engine had "cut" soon after he had taken-off, but quite coolly he had put the aircraft down again, though he was outside the area covered by the aerodrome. He then clambered out by the wrecked fence, and rushing back to the flying field, took off in another aircraft and caught up with his squadron. He wasn't going to miss any of the fun, he said afterwards.

TAKING STOCK

"Flight's" Annual Review of the State of Aircraft Construction : Modern Trends in Structural Design

By THE EDITOR

THIS issue of *Flight* is devoted largely to a survey of the present state of the art of aircraft construction. I call it an art deliberately, because although the loads, stresses and strengths can be calculated fairly accurately, and thus can be given scientific treatment, the selection of those combinations of known features which shall result in the best possible compromise is still an art, and the most successful designer is he whose instinctive appreciation of relative values—an instinct based upon long experience—is the keenest.

For our second annual issue devoted especially to the subject of aircraft construction we have been fortunate enough to persuade three well-known technicians to give us their views. In that way we have been able to cover, if only briefly, the whole history of aircraft structural design. Mr. W. O. Manning, whose experience dates back to 1911 or so, compares design during the last war with that of the present. Mr. Robert Lickley surveys the main forms of stressed-skin construction in current use, and Mr. J. D. North, whose practical experience goes back nearly as far as that of Mr. Manning, reviews the trends of structural design from an entirely new angle, and gives his views on likely future developments.

From a study of these three articles it is obvious that, for the present, light-metal construction holds almost undisputed sway. Its strength-weight ratio is such that it is well suited to the light forms of structure demanded in aircraft, the density being so low that excessive additional stiffening is not needed to stabilise the structure.

Geodetic Construction

In this connection I should like to say a few words about geodetic construction. The subject does not fall within the scope of any of the articles, although Mr. North does refer to it very briefly, expressing the view that some day the geodesics may coalesce into a continuum. The Vickers type of geodetic construction can, it seems to me, be regarded as a variation of the self-stabilised shell, or "lobster claw," in which triangles of shell have been cut along two sides and rolled up on their bases to form the geodesics. I cannot help feeling that aircraft will have to become very much larger, or else the wing loading will have to go up a lot, before it would pay to unroll those triangles and re-form them into a solid shell again, particularly now that a manufacturing technique has been evolved capable of dealing with a difficult production problem.

Mr. Manning, as was to be expected, has a soft spot in his heart for wood. So, I confess, have I. We both realise that many modern aircraft types could not possibly have been built in wood, owing to the high local stresses encountered. But there are classes of aircraft, apart from trainers, in which wood could be used with advantage—the roping into the industry of many firms not now engaged on aircraft being not the least important of these.

Mr. Lickley touches upon a point to which *Flight* has referred on many occasions. He feels, as do we, that the number of rolled and extruded sections now in use is excessive. Every designer seems to use his own, and it would be difficult to put up a good case for the retention of all of them on the grounds of structural efficiency. Mr. Lickley, who is in a far better position to judge than I am, asserts that a great degree of standardisation could be introduced without bringing with it any measurable increase in weight. With his plea for a reduction in the huge number of materials specifications now in use I am in full sympathy. As he points out, most of the existing materials could be regrouped to fall into a very few classes (Mr. Lickley suggests three).

There is one feature of aircraft design which has not been dealt with in a special article. I deliberately refrained from inviting contributions on aerodynamic design because I knew that our designers would hesitate to commit themselves to print. They know what schemes are in the wind, and they would have hesitated to run the risk of giving away information which they have in virtue of their positions.

I, not being in the Air Ministry's confidence and not having access to secret aircraft specifications, can only offer, as a substitute, my own views on what I think must logically be "the next step" if the increased performances which the stress of war will inevitably demand are to be attained.

At the risk of being slightly rude to our designers, I would say that I think they have been too prone to take the line of least resistance and to shirk their responsibilities by merely asking for a few more "horses" from the engine designers.

"The Next Step"

It is not reasonable to expect specific engine powers to go on increasing indefinitely. There will have to be a lot of cleaning up of the aircraft as well. Already undercarriages and other excrescences are made to retract into the interior so as to present a flush surface. There is little more that can be done in that direction. The only item which still offers scope for burial is the engine, and the only places in which it can be buried are, quite obviously, the wings and fuselage.

Single-engined aircraft are probably already as clean as they can be made, with the exception of relatively minor refinements. But something can still be done, and will have to be done, to improve the aerodynamic efficiency of twin-engined and multi-engined types.

If engine designers will co-operate by producing power plants which can be buried in the wings, and can at the same time form part of the wing structure, well and good. Failing that, obviously we shall have to put two engines in the fuselage and either drive wing airscrews through shafting, or contra-rotating airscrews in the nose of the fuselage. I imagine that the choice will be settled by tactical rather than by technical considerations.

"FLIGHT" ACHIEVES NEW RECORDS

THIS special number of *Flight* sets up two new records in the world of aeronautics both in circulation and the number of manufacturers' announcements.

Interest in the exclusive features of this journal, notably the articles discussing military aircraft and the data and pictures of German aircraft, is such that the demand in recent weeks has gone up by leaps and bounds. The present number, mainly devoted to Aircraft Construction, not only achieves a new record in the number of copies ordered for home and overseas distribution, but with a total of 156 pages it is the largest issue produced since *Flight's* Olympia Show Number of 1929.

This double record constitutes a fitting testimony to the strength of the British Aircraft Industry, and the pre-eminence of *Flight* in the aeronautical world.

wing loading to 80 lb. per sq. ft. and load factors to 15 on "one-piece" wings without apertures might bring the self-stabilised shell in sight. Perhaps the ingenious Vickers' wing foreshadows the coalescence of its geodesics into a continuum.

Further important changes in wing economy may follow a more perfect distribution of mass, with consequent reduction of shears and bending moments. A great increase in scale at one and the same time makes possible, and is made possible by, such arrangement.

In the absence of such external causes I believe structural changes will be principally influenced by manufacturing considerations, which are outside the ambit of this note.

Fuselage Design

The body may be dealt with briefly. Conventionally it may be represented as shown in diagram (Fig. 4). Except in a few places, the air pressures on the shell are unimportant except as stabilising the shell. The possibility of making structural use of the internal pressure in pressure cabins is worth noting in this connection. Generally the scale of cross-section compels larger radii of gyration than would more economically balance skin stability (cf. economics of thickness/diameter ratio of tubes). The requirements of rigidity thus have less independent influence on the structure. Essential excrescences, necessary "leaks," less adverse gradients and other factors may make smoothness not quite so important, but in the absence of reliable quantitative data the body should be as smooth as practicable. Alternatively to the plain shell, which, unless the cross-section is relatively small, is to be stabilised by stringers and rings, local reinforcement (longerons) fulfilling similar functions to the wing spar flanges may also serve to join segments for separate fabrication or replacement. The observations already made on wing structures which are relevant to the body will be readily appreciated. Many of the most uneconomic features of the body are due to concentrated loads. There seems to be an opportunity here for improvement, not least with collaboration of engine designers.

The stabilising organs are but wings in miniature, at least relatively. Where they are absolutely small, scale-influence on structure weight will permit simplification from normal wing construction; relative shell thickness from consideration of service ability is high, and may allow a partial suppression of the spar-rib-stringer system.

The directive organs as movable parts of the wing and stabilising organs are in form-continuation of these. Situated as they are far behind the transition point, smoothness is less important. Rigidity (in which must be included the whole system) is of paramount importance, as is mass distribution. It is usually necessary to adjust the latter by balance weights, and the structure is designed to reduce these as much as possible. Hence the concentration of mass at front of the hinge line, and use of a fabric-covered skeleton.

Alternative Materials

The characteristic structures have been discussed, at least as to certain details, on the assumption that the material employed was light alloy. Although this is representative of current practice, it is worth while mentioning briefly certain alternative materials and their influence on structure.

It is not possible to do more than notice very briefly some effects of material on that part of the structure which carries stresses arising from air loads.

The principal materials employed, or envisaged, are alloys rich in (1) iron, (2) aluminium, and (3) magnesium, respectively; (4) natural woods and (5) reinforced plastics. The forms of structure already discussed are those appropriate to groups (2) and (3). Identical structures could not be contemplated in employing group 1 (steels), but the technique for providing local stability with thinner shells and members is established. Steel lends itself less readily to graduation (effect of structural taper), and in very thin material loss of weight due to manufacturing tolerances is more serious. The more extensive employment of steel is likely to arise, if at all, from necessity and not from convenience. Within limits the specific mechanical properties of materials in groups 1, 2 and 3 are equal, and for structural discussion they may be regarded as isotropic.

Group 4 (woods) may also be regarded as having equivalent specific properties in certain directions. The wide departure from isotrophy of the natural material gives rise to considerable deterioration of specific strength and elasticity when attempts are made to approach isotrophy by structural arrangement (e.g., 3-ply). Rigidity may be viewed structurally as a struggle between l/k and t/r in the conventional use of the

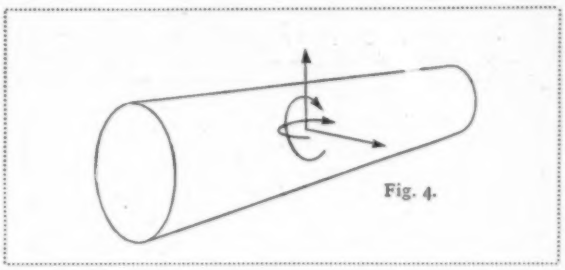


Fig. 4.

expressions. In a hollow laterally-loaded strut the ratios of length to radius of gyration and shell thickness to local curvature are the criteria of general and local stability. Group (1) has difficulty with t/r, groups (2) and (3) offer effective compromise. Group (4) approaches difficulty with l/k.

Group (5) is, in its aeronautical application, still in its infancy. The most favourable combination of resinoid and reinforcement may in certain directions compare favourably with the other groups in specific strength and rigidity. The effect of the orientation of the reinforcement on isotrophy is most marked, and combined with the brittleness of the resinoids generally employed tends to detract from the favourable consequences of low density. On to-day's scales the l/k-t/r compromise should be very favourable. At the present stage of development it would be wise to hope for everything, expect something and anticipate nothing. If I were unwise enough to gamble, I should be inclined to back something from the ethenoid stable for a place.

Biologically Speaking

From the outline already given it will be seen that I see few internal reasons for marked morphological variation. Considering *H. volans* from two other aspects, viz., genetics and embryology, we may receive some clue to the future. The prototype ("production" aircraft being, as it were, merely vegetatively propagated have no genetic significance) may be considered as arising from the conjunction of the male parent—the actual or potential customer, and the female parent—the designing-constructing organisation. This simile not inaccurately reflects the respective labours of the two parents; the hereditary characteristics may be viewed thus: the operational requirements as dominant in the male, and experience-technique as dominant in the female. Incompatibility usually results in excessively delayed

"Flight" photograph.

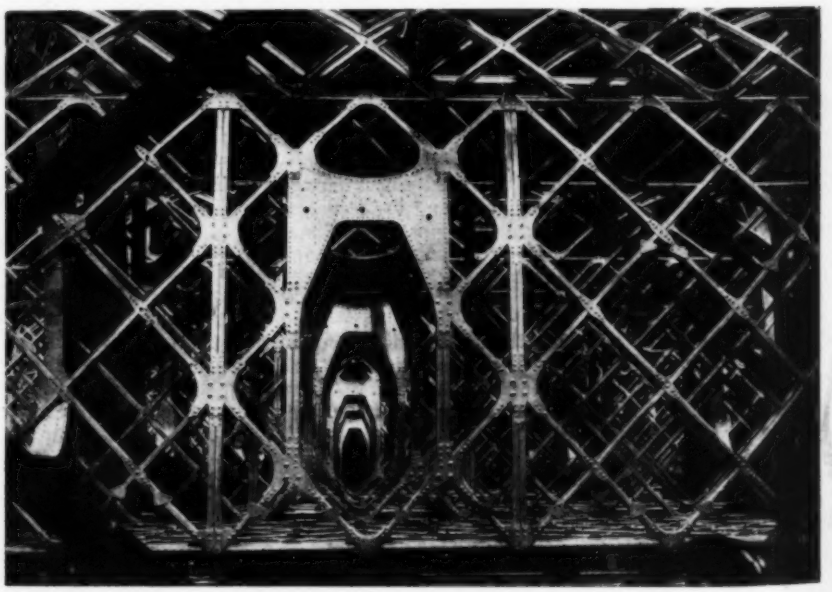
The Boulton Paul Defiant, for the design of which Mr. J. D. North was responsible, reflects admirably his biological outlook. The clean lines were obviously inherited from the "female parent," while traces of the influence of the "male parent" are obvious in the functionally necessary excrescences on top of the fuselage.

gestation or alternatively abortion. The recapitulation of evolution, often exhibited in the embryo, takes place in the mind of the designer. Casual mutations are not to be expected, so evolutionary development is the result of controlled breeding. Morphological changes may be expected only in so far as the technique-experience of the designing-constructing organisation can develop to the necessary degree of compatibility with the operational requirement of the customer. No more potent influence on the evolution of *H. volans* can be expected than war. The rapid developments of war will compel the several varieties of *H. volans* to keep pace with his changing environment or perish; when and how it is beyond our power to say.

AUTHOR'S NOTE

I have taken advantage of Garett's conception of the machine as a mechanical extension of mankind to give a biological twist to the discussion. This is convenient because it gives what appears to me to be a more comprehensive view-point from which to examine evolutionary trends. In addition biology, being so much concerned with evolution, has a terminology which, though normally applied to living organisms, supplies something which is missing from engineering terminology. Most of the terms are in use as a part of everyday speech, and their significance is clear from the context. There are, I think, two possible exceptions. Morphology is the science of form, contrasted with physiology—the science of functioning; in other words, "what it is" contrasted with "how it works." Taxonomy is systematic classification for convenience of study—a technical rather than a scientific process—analogous to systematic grouping of the pieces of a jigsaw puzzle before attempting to put them together to make up the picture. J. D. N.

GEODETIC CONSTRUCTION FORMS A CLASS BY ITSELF

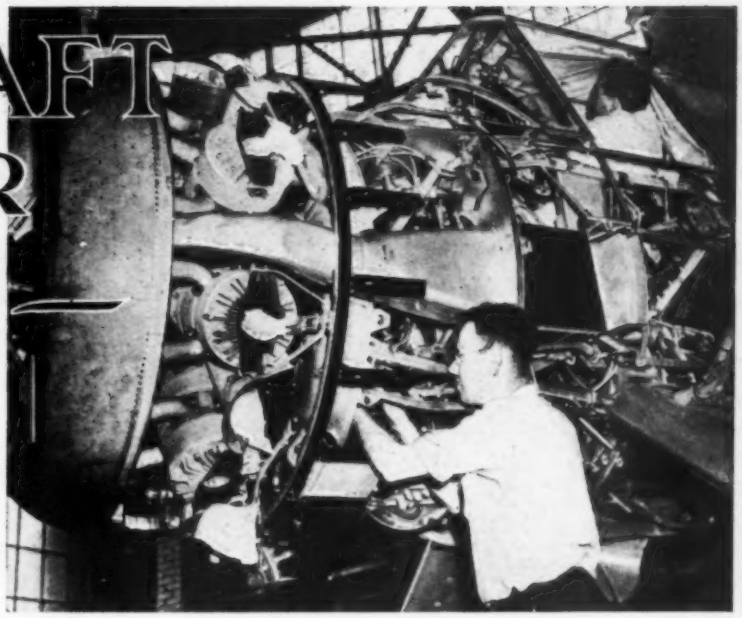


"Perhaps the ingenious Vickers' wing foreshadows the coalescence of its geodesics into a continuum." This *Flight* photograph, while not depicting a Vickers wing, does at any rate show numerous examples of the geodesics which Mr. North thinks may one day coalesce into a continuum.

Lest readers should think that a new Vickers monoplane with wings of enormous depth, having gangways down the span, is about to emerge, we hasten to explain that the picture shows a view across a number of Wellington fuselages. The "gangway" is formed by the openings for the wing spar.

AIRCRAFT POWER PLANTS

Some Considerations Affecting Their Design and Construction: Modern Trends



Completing the installation of a Bristol Perseus nine-cylinder sleeve-valve radial in a Canadian Westland Lysander. The Bristol series of sleeve-valve engines forms one of the most important advances in construction for many years.

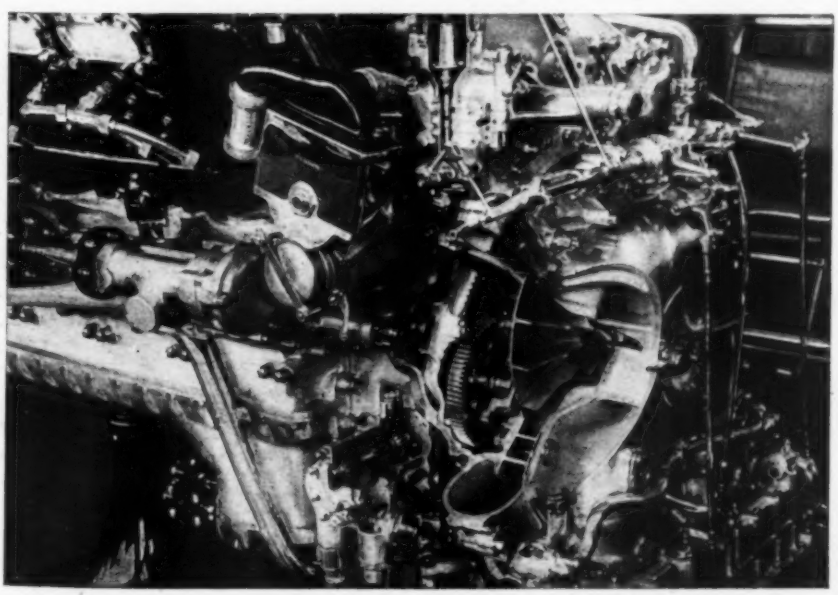
PROMINENT designers and equally famous colleagues—Fedden, Elliott, Mead, Ellor, Banks, Ricardo and Wilkinson, to name but a few—have written unstintingly and with great vision on aero-engine development. In these notes we shall, if it suits our purpose, shamelessly draw from their classical works.

First let us bow to Mr. A. H. R. Fedden for his dictum (*Flight*, December 14, 1939) that long-term research on a large scale is now an essential preliminary to all aeronautical designs and vital to our national interest. Mr. Fedden further explained that engine types are becoming much more stabilised and that the field of sensational experiments is becoming restricted. There is little likelihood, however, that our engines will become stereotyped, though standardisation is much to be desired; the enemy, as will be suggested by subsequent reference to his products, will keep hard at work our most resourceful brains.

Before outlining present-day constructional technique we may with advantage survey current demands. Engine development is now at a particularly interesting stage. For a long time we have been squeezing power out of a few basic designs which appeared several years ago, some units having been made to give about double the specific output for which they were originally intended; but in recent months a strong crop of entirely new engines has appeared. Contrary to what is often suggested, these units will be used with equal advantage by military and civil designers.

As power demands increase, the field of usefulness of the single-row air-cooled radial—still the most commonly used type—will be more and more limited. Although the first cost of this type of engine is low, the use of the minimum number of cylinders at maximum displacement gives a comparatively rough-running engine (this, of course, will be reflected in life) and one of maximum frontal area. The fourteen-cylinder two-row unit is consequently taking over many of the duties of the single-row "nine."

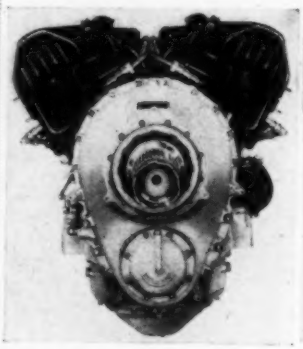
Briefly, engines can be short and have a large



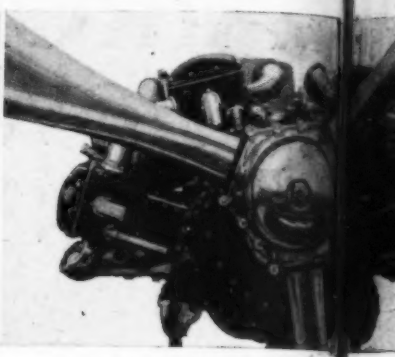
Typifying the wondrous complexity of the modern aero engine is this view of the rear end of a Rolls-Royce Merlin with sectioned supercharger.

The frontal views shown on the right are more or less to scale. The Merlin represents the latest practice in the construction of vee-twelve liquid-cooled units and makes an interesting comparison with the inverted Daimler-Benz. The big Allison is virtually a combination of two vee-twelve units. The first successful twenty-four cylinder engine of H layout is the Napier Dagger which is of approximately the same power as the Bristol Taurus radial shown next to it. Although the Dagger is of smaller frontal area it is longer than the Taurus and has a larger "wetted area."

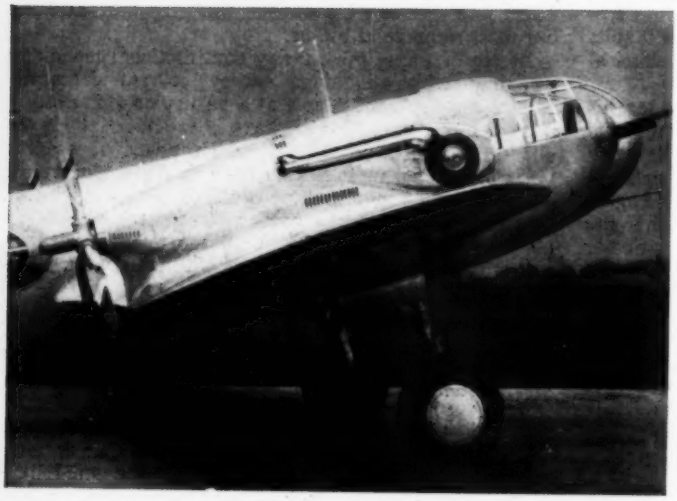
AIRCRAFT POWER

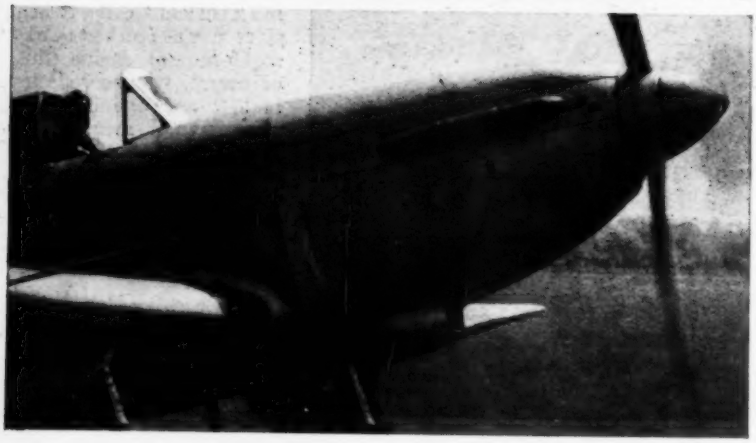


1. Rolls-Royce Merlin.



2. Allison XB-3420.





frontal area or lengthy and of small cross-section. It is unwise to take frontal area as the deciding aerodynamic factor; wetted area is the safer criterion. The method of arranging cylinders is largely determined by the cross-section and is influenced by the need for good balance, reasonable bearing loads, even distribution, satisfactory cooling and even torque.

Although radial combinations of 30 cylinders are quite feasible, the most powerful radial now running—the Wright Duplex Cyclone—has only 16. Small-diameter radials and vees in cowlings of circular section make good "airscrew supports" due to their shape, whereas engines of H, X or W layout may be happier when submerged completely within a wing or fuselage.

A particularly interesting development which has lately appeared is the American Pratt and Whitney Double Wasp 14-cylinder two-row radial with extension shaft. This combination results in a cowled radial installation comparable in efficiency with contemporary liquid-cooled practice. Cooling air is taken in through an adjustable scoop below the cowling and just behind the spinner, and is exhausted through controllable gills round the trailing edge of the long-chord cowling.

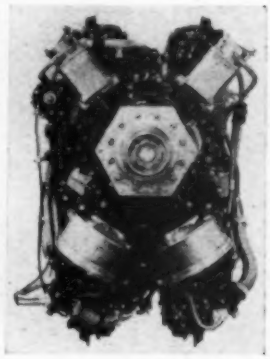
The vee-type engine will probably be retained for powers of 1,500-2,000 h.p. In this country we are continuing to develop the upright vee (e.g., Rolls-Royce Merlin and Peregrine), and the Americans and French are working on similar lines (Allison, Hispano-Suiza and Lorraine), but the Germans are proceeding with the inverted-vee arrangement (Daimler-Benz and

The top view of the three on the left shows one of the most modern installations of an air-cooled radial engine. This is on the Double Wasp-powered Curtiss P.42. Below it is one nacelle of the Bell twin-engined pusher fighter showing how one completely cowled Allison engine drives its pusher propeller. The exhaust-driven supercharger and the gun position ahead of the engine are points of interest. The bottom view shows the exquisite cowling lines of the Boulton Paul Defiant, which has a Rolls-Royce Merlin engine.

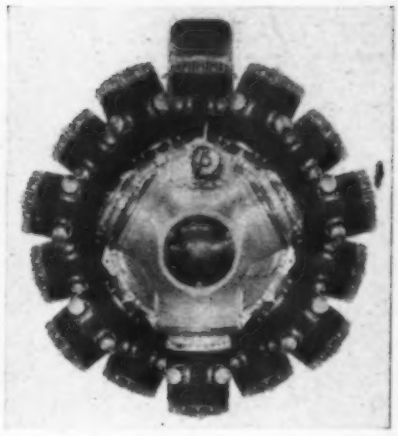
PLANTS (CONTINUED)

XB-3420

3. Daimler-Benz DB 600.



4. Napier Dagger.



5. Bristol Taurus.

Junkers), though despite their claims it is difficult to see where, even in "ideal" installations—much less in present-day examples—this arrangement scores.

The engine of H section as exemplified by our Napier Dagger will doubtless establish itself even more strongly. The Dagger, which may be the prototype for more powerful units, is virtually two engines in one, being in effect a combination of a pair of "flat twelves" joined by a common crankcase and driving through spur gears a single airscrew. Another method of obtaining increased power is exemplified by the Fiat AS-6 racing engine which is nothing more than two twelve-cylinder vee-type units placed back to back with a gear box between them. There are two concentric airscrews, one for each engine, driven through off-set gearing and concentric shafts. A French bomber has been designed to utilise two sets of Hispano Suiza Series Y engines joined in similar fashion.

Cooling

The air- *versus* liquid-cooling controversy continues, and is likely to do so. Mr. Fedden, the Bristol designer, maintains that friendly rivalry is beneficial to both and the competition afforded stimulates engineers to greater achievement. In this connection Mr. Fedden deprecates the opinion expressed by Mr. F. R. Banks that for powers in excess of 2,000-2,500 h.p. the liquid-cooled engine will be more generally used. Air-cooled engines of the multi-bank radial types and of the X and H layouts are possible in large sizes, and the problems involved, he states, are no greater than when liquid cooling is employed.

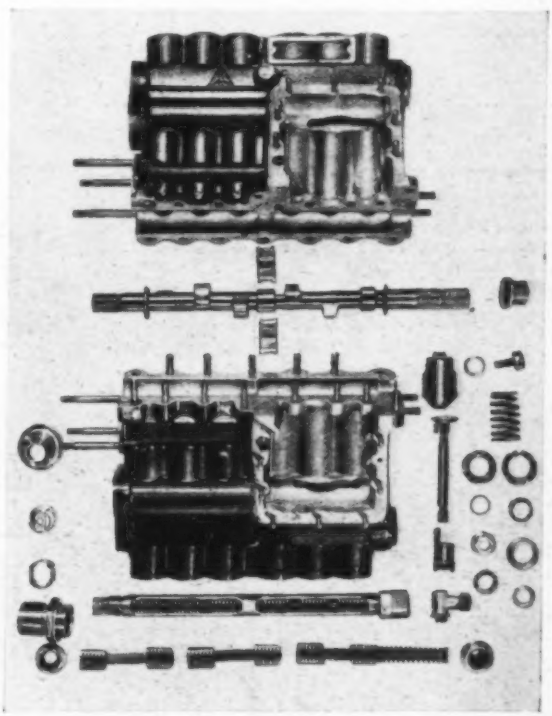
The provision of cooling gills and of sufficient cooling surface can be obtained, and the installation can be arranged so that the drags of both types of engine are almost exactly comparable. Moreover, the cooling of a cylinder by air is a problem which is still being actively pursued, and further developments in this direction are much more likely, according to Mr. Fedden, than in that of the more fully developed liquid-cooled cylinder.

In this connection Mr. Fedden quotes the recent N.A.C.A. experiments with cylinders of large cooling surface. This states: "By increasing the fin area of a standard head six times and by doubling the cooling surface of a barrel, the power obtainable from a cylinder of given size has been trebled without increasing the cooling loss or the temperature."

Although it is recognised that engine weight contributes to aerodynamic drag by its influence on wing area, power plant weight is not such an important consideration as in the past. Mr. Mead points out that weight alone is not a true criterion, but rather its effect on the overall efficiency of the aeroplane. Illustrative of this is the constant-speed airscrew which, though it weighs anything from 60 to 80 per cent. more than the fixed-pitch type, permits take-off at a 10 to 30 per cent. greater gross weight.

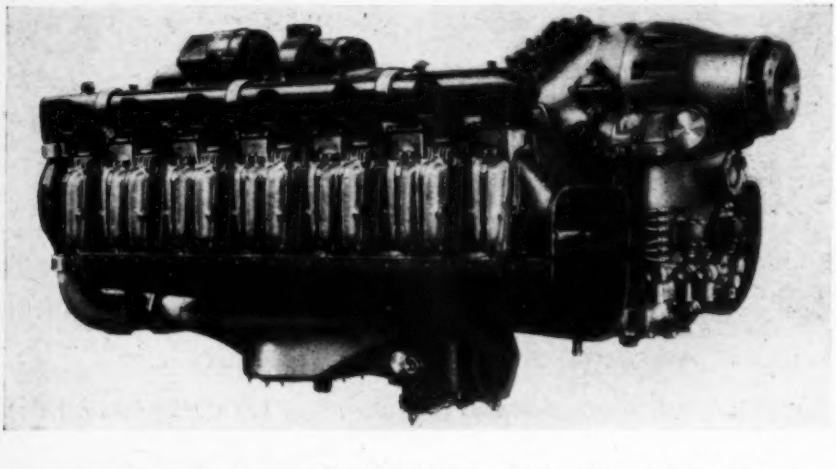
Direct Injection

A popular and topical controversy is the "petrol-injection or carburetter" argument. A well-known American engineer when asked for his views on the benefits of fuel injection compared with the carburetter stated that if the aero engine, as developed, incorporated fuel injection instead of a carburetter there would have been people just as anxious to fit the carburetter as they



The injection pump unit of the Junkers Jumo 211A engine shown dismantled. A centrally disposed camshaft with six cams actuates the twelve injection pumps.

AIRCRAFT POWER PLANTS (CONTINUED)



Little has lately been heard of "flat" engines as exemplified by this Potez.

are apparently anxious to adopt fuel injection. Fuel injection may utilise any of the following methods: Direct-injection into each cylinder, using a high valve overlap; injection into the induction branch of each cylinder, either close to, or remote from, the inlet valve; or injection into the eye of the blower.

A *British Experiment*

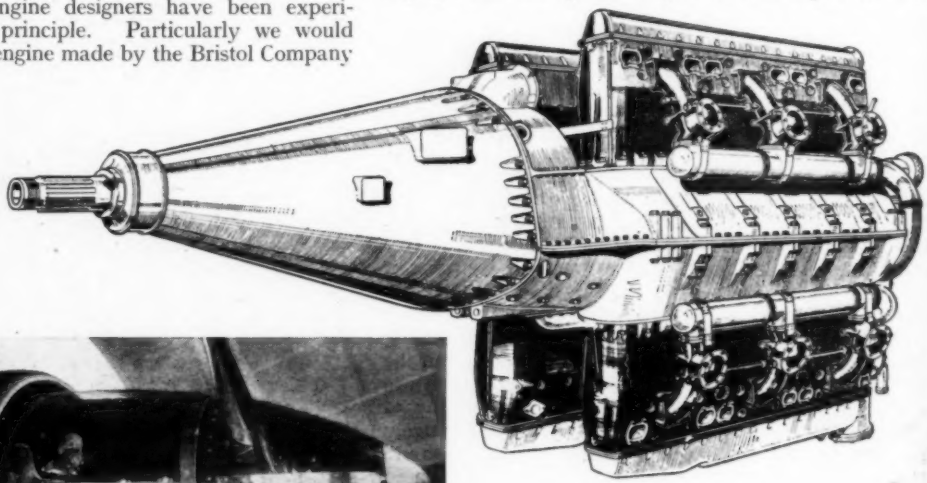
The greatest progress with petrol injection has been made in Germany; certainly that country is employing the system to a much greater extent than any other. Although it was not until January 18, when *Flight* published the first full description of the Junkers direct-injection system, that the world was initiated into German secrets, it must not be forgotten that for very many years aero-engine designers have been experimenting with this principle. Particularly we would mention the Draco engine made by the Bristol Company for the Air Ministry in 1932. Essentially the Draco was a modified medium-supercharged Pegasus. Two Bosch fuel pumps were used, fuel being injected into the inlet elbow of each cylinder and against the air flow. Extremely promising results were obtained, but tests were discontinued in 1935 for the following reasons: There was no measurable reduction in fuel consumption; the rated altitude of the Draco was slightly less than for the standard Pegasus (due to the reduced density of the air in the supercharger owing to the absence of petrol); and the distribution of radial engines was, in any case, excellent and could not be improved by petrol injection.

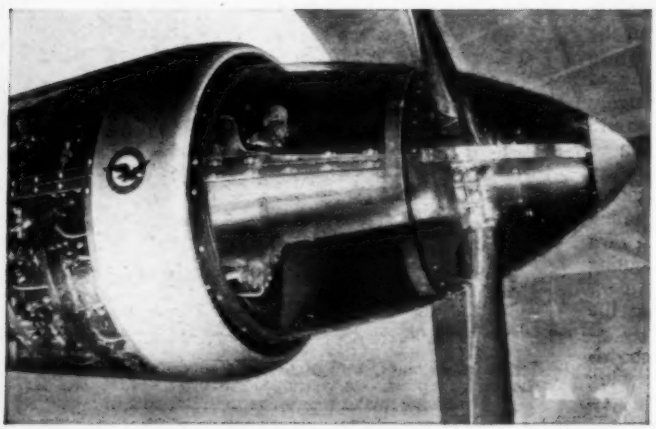
Icing Eliminated

One indisputable advantage of direct-injection is the elimination of carburetter icing; this, in conjunction with the promise of better distribution for certain types of engine and possible improvement in fuel consumption, may lead to its increased adoption.

For the time being it seems that heavy oil, or diesel, engines will remain in the background due to the preoccupation of designers with problems attaching to the high-performance petrol engine for military use. The design of current aircraft diesels is quite as varied as that of contemporary petrol units.

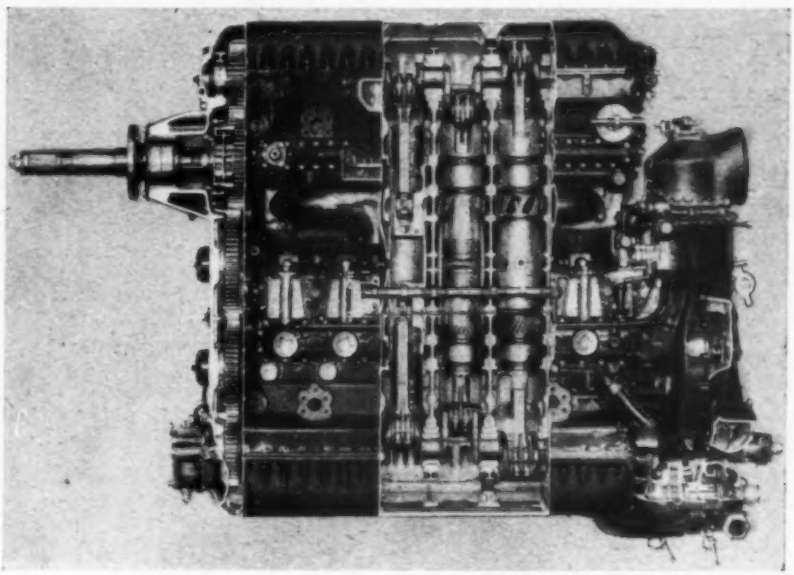
Mr. Ricardo, who has made a deep study of diesel problems, states that there are three main avenues of approach: The high-compression, four-cycle, lightly supercharged engine; the high-compression, two-cycle unit; and the relatively low-compression, highly supercharged four-cycle type. Current experimental units include radial adaptations,





Two examples of extension shafts: (above) on the big twenty-four-cylinder Hispano-Suiza H engine and (below) on a beautifully cowled Pratt and Whitney Double Wasp.

AIRCRAFT POWER PLANTS (CONTINUED)



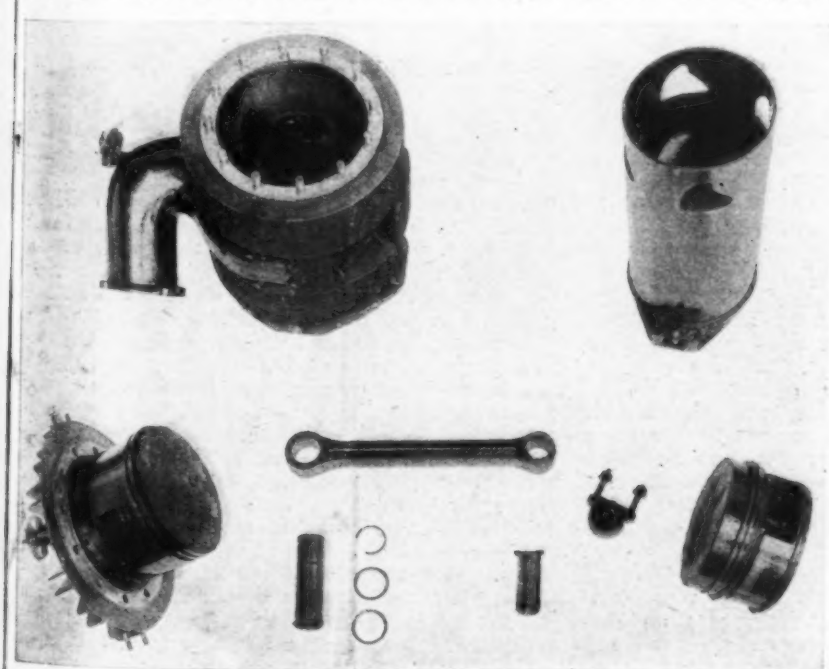
The German Junkers Jumo 205 six-cylinder twelve-piston diesel demands exceptional casting technique.

notably the German B.M.W.-Lanova glycol-cooled unit which has small radiators between the cylinders; the vertically opposed Junkers Jumo six-cylinder twelve-piston type; a number of vee-type engines; the Jalbert-Loire sixteen-cylinder water-cooled H-type engine; and the experimental 2,000 h.p. twenty-four-cylinder Junkers which has a frontal area of only eight square feet.

Space does not permit an exploration of the problems affecting the construction of aircraft diesels, so returning to petrol engines we may take up the question of cylinder design. The dimensions of a cylinder are a compromise between displacement and operational speed to secure the best output per litre consistent with reasonable cost. It is generally agreed that the maximum size of cylinder has in all probability been reached. The trend is toward the use of smaller cylinders and higher operational speeds. Advantages of the smaller cylinder are the greater output per litre (due chiefly to the reduction in reciprocating weights, which permits higher operational speeds) and the improved cooling which permits heavier boost for a given fuel. In view of the experience gained in building engines with cylinders ranging in bore from 5 to 6¼ inches, Mr. Mead is of the opinion that the 5½-in. cylinder is the best compromise at present between power and cost.

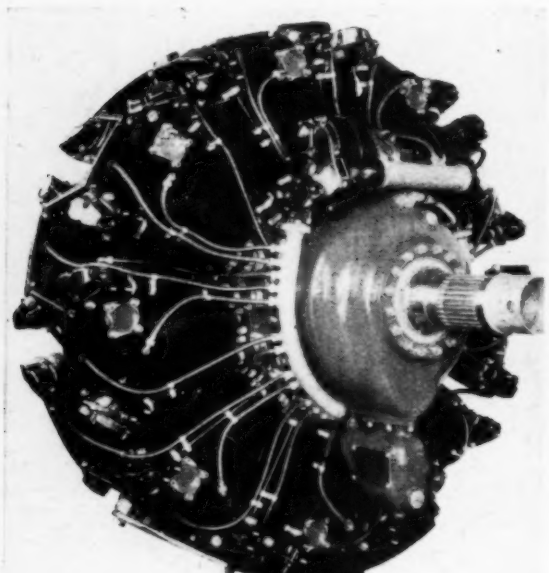
The high operational speed permitted by small cylinders is limited by the valve gear and the crank-pin loading. Up to the present continued refinement of the poppet valve mechanism has enabled it to keep pace with requirements, and take-off r.p.m. of 2,700 are not uncommon. It is admitted, however, that there is little opportunity of much further increase in poppet-valve speeds for a given valve size; this is one reason why we may be thankful for the Bristol Company's pioneer work in applying the sleeve-valve principle to aircraft engines. As Mr. A. G. Elliott lately pointed out in *Flight*, the exhaust valve, in relation to its size, has probably had more time and money spent on its development than any other single component. It is undergoing continuous improvement, and future development will be directed towards further improvement in cooling coupled with the development of materials which will resist the corrosion of leaded fuel and maintain good mechanical properties up to higher operating temperatures.

The Bristol Company feels that if the same development had been given to the sleeve-valve as to the poppet-valve modern air-

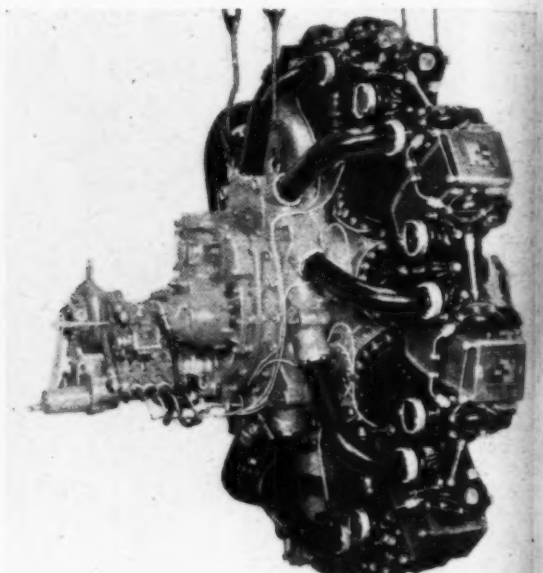


Illustrating the simplicity of the Bristol sleeve-valve engines. Actually the components shown belong to a Perseus.

AIRCRAFT POWER PLANTS (CONTINUED)



The Wright Duplex Cyclone, an eighteen-cylinder two-row radial which is claimed to deliver 2,000 h.p.



The B.M.W.-Lanova 114 V-4 diesel showing the glycol radiators between the cylinders. The compression ratio is 14.8 : 1.

craft engines would be of better performance and cheaper to manufacture. The sleeve-valve engine, particularly the single-sleeve Burt McCollum type, is claimed to offer a number of advantages, the greatest being simplicity; absence of hot spots on the combustion chamber; and excellent valve diagrams facilitated by the rapid opening and cut-off. Already the Bristol Company has in service the following sleeve-valve radial units: 900 h.p. nine-cylinder Taurus, 1,050 h.p. fourteen-cylinder Taurus, and 1,400 h.p. fourteen-cylinder Hercules. A further great advantage of the sleeve-valve is that the compression ratio of the cylinder may be raised by at least half a ratio (the Bristol Company claims one whole ratio) above that of the corresponding poppet-valve cylinder.

Superchargers

In the first instance superchargers were fitted to restore ground level power at altitude, fuels then in use prohibiting any really useful measure of ground boost. Nowadays supercharging is used, not only for raising altitude output, but for increasing take-off power. The most popular type of supercharger is the engine-driven centrifugal type placed between the carburetter and the cylinders. The Germans on their liquid-cooled engines use pressure carburetters with the blower on the air inlet side of the carburetter, air only being taken through the blower. Placing the blower between the carburetter and the cylinders practically prohibits the use of an inter-cooler, the absence of which means that the amount of boost is limited by the temperature of the mixture, which, in turn, is a function of the peripheral speed of the impeller.

A great number of modern high-powered engines are being fitted with a two-speed supercharger which combines the high take-off characteristics of a medium-supercharged engine with the maximum performance at high altitudes obtainable only by full supercharging.

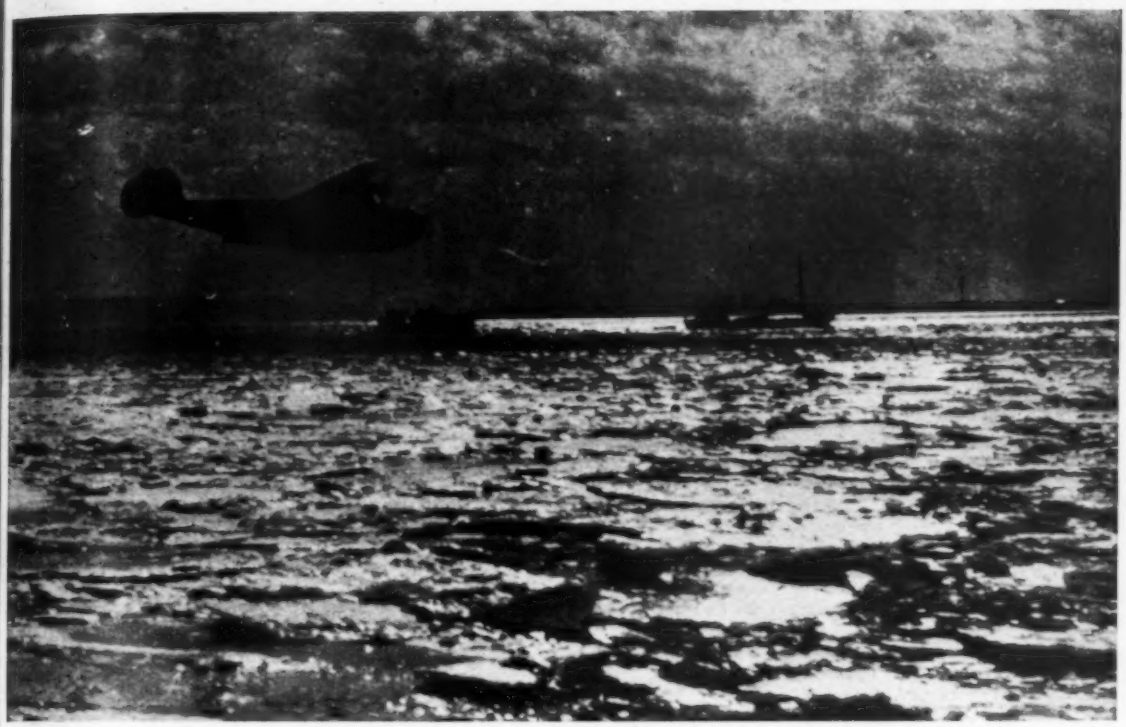
There seems to be little hope of further improvement in single-stage supercharging without the use of an inter-cooler. It has been pointed out by Mr. Mead that the practical way to employ one on a radial engine with carburetter is to use a two-stage supercharger and place the inter-cooler between the stages. Such a system provides for the decided increase in boost which will be required if transport operations are to be carried to materially higher altitudes. Where the supercharger is not required for distribution, as in some types of in-line engines, the cooler may be placed between the supercharger and the carburetter by locating the supercharger ahead of the carburetter.

Naturally, the ideal system would be one in which the amount of supercharging could be regulated to fit every operational condition and altitude. This would require an infinite number of impeller speeds for a fixed impeller and diffuser combination, and it should be possible to use an inter-cooler without interfering with distribution. When used with suitable distribution or direct-fuel injection the exhaust turbo supercharger, as developed in America, meets these requirements and has the incidental advantage of reducing exhaust noise.

Equal distribution has a definite bearing on fuel consumption as the leanest cylinder limits the performance of the entire engine. Supercharging has generally improved distribution because of its effect on the temperature of the charge, while in the radial engine particularly there has been a further improvement due to the symmetrical nature of the intake system which is centred on the impeller. As already inferred, direct fuel injection holds further promise.

Regarding crankshafts, at least six throws per shaft may be used with satisfaction. However, due to torsional vibration, even the six-throw shaft presents a difficult problem in an engine of high power. An improvement results where a relatively small number of cylinders is used, operating at high crank speeds.

COMMERCIAL AVIATION



EVEN ON THE OTHER SIDE: The American Clipper, returning to the United States, finds Baltimore harbour choked with ice. It ultimately found a clear patch on which to sit down.

LETTERS VIA BERLIN

"A. Viator" on Cross and Crossed Passengers, the Last Great Frost, the Derby Family, and Flying Dervishes

A QUAINT situation arises when people in London obtain correspondence from friends in neutral countries stamped with the German High Command censor's stamp, the centrepiece of which is a worried-looking eagle with spots before his eyes.

From Copenhagen every day, I believe, you can take a machine for Berlin as well as for London. Possibly, some harassed mailing clerk put the London mail on the Berlin plane, or the Post Office there, disliking the taste of the gum on one label, insisted on licking nothing but "Berlin" labels cunningly sweetened and flavoured with rum by the Berlin Ministry for Honied Words and Sugar-coated Pills.

Anyway, the incident reminds me of the piping times of peace at an airport which my older readers may have heard of from their parents, to wit Croydon. Thence you might have as many as ten air liners of various shapes and sizes departing at about the same time for different capitals of Europe. One time there were two small business men, subfusc as to clothing, fussy as to manner and bearing, almost identically badly rolled umbrellas, and bulging brief cases. One was for Brussels and the other for Amsterdam. On the tarmac were two Douglas D.C.3s, one bound for Brussels and the other for Amsterdam.

Two groups of passengers were carefully shepherded through passport formalities, and yet, somehow or other, the two little mass-produced business men got mixed. The one whose heart belonged to Brussels went to Amsterdam, and the other, whose Old Dutch awaited him in Holland, arrived in Brussels. There is nothing impossible, so far as I know, in the picture of a Briton arriving in Berlin with a vague haunting notion that something is wrong somewhere, or of a German arriving in England by air.

Let us hope that in either case the unhappy traveller will be given a good stiff glass of the local spirituous liquor and returned to the place whence he came. I even go so far as to believe that the friendly outlook of the professional aviation people in either country towards an errant passenger, which has become almost an instinct with ground staffs, everywhere, would expedite such a happy repatriation.

Just when I had composed a lovely bit to placate the Censor (about my plumber downing tools and going home for his solar topee on account of the tropical weather which had congealed the water in the pipes and given the kitchen boiler sunstroke, complicated by hiccoughs) the Sunday newspapers let the frozen cat out of the ice bag and said it had never been so cold since the year before Waterloo, the last time the Thames froze over.

As a matter of fact, I have an old letter in my possession, dated January, 1823, but not written to me personally, which states that the Thames was frozen over at the time the letter was written, but what's a spot of accuracy to a newspaper intent on dragging in the fact that the battle of Waterloo was won on the skating ponds of Eton? Anyway, commercial aviation carried on pretty well in spite of the cold snap, and cancellations were not

due to the intense cold so much as to other factors, of which one may encounter a surprising variety in wartime.

Passengers may get huffy sometimes because *their* skies are blue and everything in *their* gardens is lovely, but air transport officials may find at the same time that, so far as they are concerned, men cannot gather grapes from thorns or figs from thisties. One may sympathise with the courteous official, not in a position to give an exact reason for a cancelled service, who is rumoured to have addressed an unfortunate passenger thus: "Sir, we cannot fly to-day because the pilot has a bee in his bonnet, the wireless operator a flea in his ear, the mechanic (whose parent is a parson) a bat in his belfry, and the steward a fly in his ointment. Moreover, we have reason to suppose that the plane has an earwig in its petrol system. I trust, therefore, that as one entomologist to another, you will accept my explanation."

No Hamburger Derby

A comic German paper known as the *Völkischer Beobachter*, vehemently asserts that some German horse-race which few people have ever heard of is to be renamed because it is now called the Hamburg Derby. I should have suggested "The Hamburger Stakes," in loving and wistful memory of a long-departed and much-regretted delicacy, and I should have left it at that, but for the fact that the *Volkslaughter Beobachter* goes on to make an outrageous attack on the Derby family: "Typical of British robbery, land grabbing, treachery, tyranny, murder, and so on."

The *Völkischer Blurbachter* says that no good German horse-race may be associated with such crimes. I imagine this contest, for such quadrupeds as have happily by-passed the sausage mill, will be renamed after one of the four or five Nazi leaders, and no good German citizen will ever dream of associating the event with robbery, land grabbing, treachery, tyranny or murder, now, will he? Incidentally, he'd better not, for though his heart may belong to Daddy his neck may be claimed at any moment by the public executioner.

I hear that those very gallant gentlemen the Finns are getting a good number of decent planes, and I look forward to the day when they will be able to bomb that insanitary neolithic settlement Moscow. I have no doubt that the anti-aircraft defences of that city are as inefficient as the rest of the Soviet outfit, and it would be a nice reply to the bombing of Helsinki. It would be lovely to hear of Stalin galloping off across country on all fours, a posture which comes natural to very primitive types when scared.

A British test pilot in America, whose job it is to try out various types of aeroplane for acceptance, is described in the *Los Angeles Times* as climbing the bullet-nosed craft, a Vultee Vanguard pursuit plane, until its spinning propeller churned the skies like an inverted windmill. He twisted it in vertical banks, dived, spun and raced over the breakers like a dervish.

It's all very well, of course, but we haven't the weather for that sort of thing and can't afford to have our already turbulent skies churned up any more.

And next time you see a dervish far from his native desert, skimming over the breakers, drop me a postcard, chum, and I'll send you a prescription. It's mostly Worcester sauce and tomato juice, with aspirins dissolved in it. You don't drink it when things are as bad as that; you have a bath in it with an ice-pack on your head and your feet plastered with freshly made mustard.

Applied Psychology

About these American planes, we are buying so many of, and which I hear will literally knock spots off anything Fritz can produce, there is an aspect of the business that even our friend Raymond Gram Swing has not spotted.

If you are in the States and you hear of a British horse ridden by an American jockey in an American race you are going to put your singlet and half-hose on that beast and then go and lean over the rails and yell yourself hoarse, in a way you never would when watching the Derby.

Air fighting is more thrilling than horse-racing, and Americans will come to talk of "our" aircraft shooting down "enemy" aircraft in flames. As I say, it does not matter who the jockey is, for it's the horse you back. Psychologically there's quite a lot in the above idea, I believe.

Dr. Goebbels, please note.

A. VIATOR.

Customs Aerodromes

LYMPNE and Tangmere Airports are now approved as Customs Aerodromes, it is notified in Air Navigations Directions, 1940 (A.N.D. 15C).

U.S. Limits Air Mails

ON January 25 the Post Office Department of the United States issued a regulation which bars from transmission by the transatlantic air mail to belligerent countries, or to neutral countries whose mails pass through belligerent countries, all articles and materials except those copyrighted.

One-Day Transatlantic Runs

THE Transatlantic service by Pan American Clipper boats has become a one-day run since February 3, when the *American Clipper* took off from Miami at 4.43 a.m. She arrived at Charleston, South Carolina, at 8.46 a.m. and took on passengers and mail. This is the temporary port of departure until Baltimore Harbour is free of ice. The timetable called for arrival at Bermuda at noon and at Lisbon in the early hours of next morning.

Air Transport Arbitration

THE Air Transport Association of America has announced that fifteen of the air transport companies, representing all the internal lines, have signed an agreement in regard to arbitration. It has been agreed that, on matters which might cause legal disputes between them, they will accept the decisions of the American Arbitration Association. This association maintains a nation-wide scheme of tribunals for the settlement of industrial controversies out of court. It is hoped that this arrangement will allow the airlines to settle their disputes with a minimum of delay, expense and litigation.

Questions which will come up for decision are expected to include agreements for mutual use of equipment, advertising methods, standardisation of flight procedure, and all the questions involved in keeping competition fair. It is not intended that this arbitration procedure shall in any way supplant the jurisdiction of the Civil Aeronautics Authority, which exerts governmental control over the air transport system.

U.S. Airline Accident Statistics

IN the first half-year of 1939 there were only 10 deaths in all American air transport, both internal and external. Of these, nine were passengers and one was a pilot. Aeroplane-miles flown amounted to 42,652,257, while passenger-miles were 357,101,671. This gives the very high figure of 39,677,963 passenger-miles flown per passenger fatality, the highest safety figure yet attained. It is three times the safety figure for the same period of 1938 and five times that for the first half of 1936.

Total deaths on the airlines for the years 1936 to 1938 were 55, 56 and 38. If the second half of 1939 turns out to be the same as the first half, the figure of 20 will show how the deaths are decreasing, despite the increasing mileage flown.

Notices to Airmen

NO. 86 of the emergency series prohibits flight over the island of Malta and its territorial waters except to the regular civil services and aircraft employed on Allied Government work. The procedure required for aircraft using the approach corridors to Ta Kali and Hal Far aerodromes and St. Paul's Bay and Marsa Xlok seaplane airports is also defined. No night landings may be effected between sunset and sunrise without the permission of the Air Officer Commanding, R.A.F., Mediterranean.

No. 87 notifies prohibited areas in the Belgian Congo over which civil aircraft may not fly without permission of the Governor-General at Leopoldville. The whole of the territories of the Bas Fleuve and Matadi are so prohibited, but aircraft may use a corridor on a bearing of 66½ deg. true for flight to and from Boma (Lokandu) airport. Areas 20 kms. in all directions from the Cornet Falls and Piana-Mwanga electricity stations are also prohibited.

AIR-SCREWS

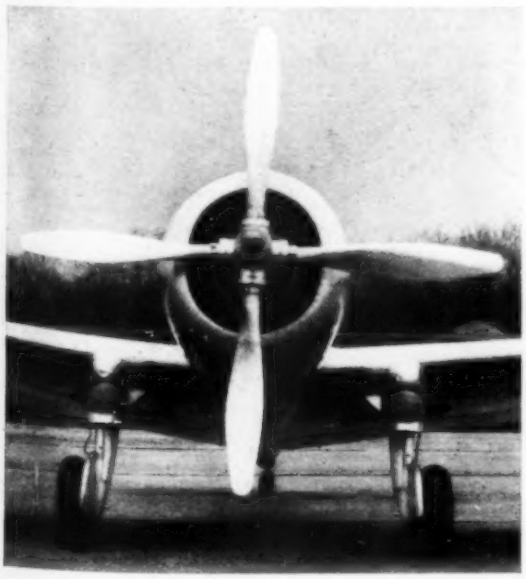
New Developments in the Variation of Pitch : Blade Manufacture

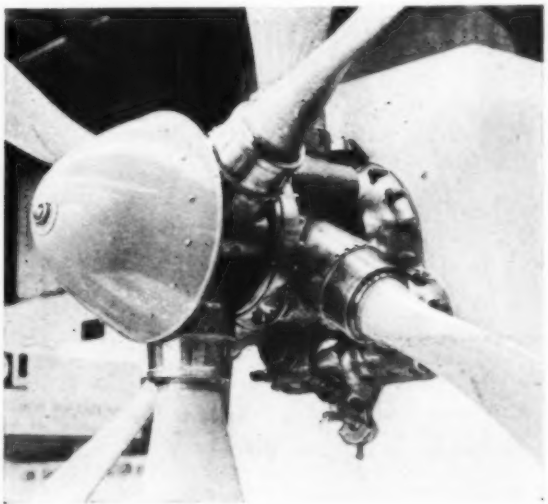
The great Hycromatic airscrew in the centre is intended for engines of over 2,000 h.p. and makes the smaller constant-speed Hamiltons for the 1,000 h.p. Wright Cyclones look puny.

IT was not many years ago that arguments raged in the columns of *Flight* as to whether the variable-pitch airscrew was worth while. To-day such airscrews are an indispensable factor in aircraft development. With engines of comparatively low power and with relatively slow aircraft, the airscrew designer was able to indulge his fancy without performance being very seriously affected. There was a tendency to use airscrews with excessive diameter and blade area because the low blade angles resulting gave improved take-off characteristics despite the large drop in engine r.p.m. As power and revs. went up trouble was experienced with losses due to excessive tip speeds and recourse was made to thin metal blades to increase the permissible tip speed and permit the retention of the direct-drive engine. However, even for thin blades tip speed became excessive; this is one explanation of the wide adoption of reduction gearing. As gearing came into vogue aircraft of clean design, heavy loading and high top speed were introduced, and circumstances led to the production of airscrews of such high pitch ratio that they were stalled for take-off, and they had to be used on aircraft which were in any case very difficult to get off the ground. Then arrived the variable-pitch airscrew to save the day.

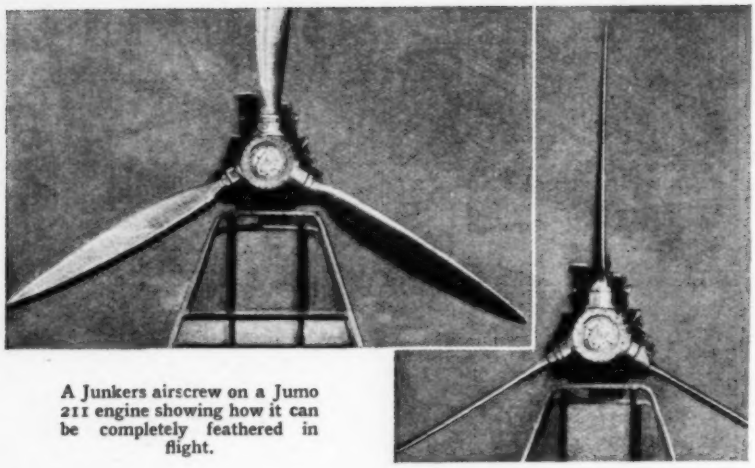
Nowadays the problems of airscrew development are not bound up so closely with methods of changing the pitch of the blades but with considerations of weight and size. In the case of an engine with 2,000 take-off horse-power an eighteen-foot, three-bladed constant-speed airscrew is required to give a cruising speed of 225 m.p.h. at 10,000ft. with 60 per cent. of the power; the weight is approximately 800 lb. The diameter of airscrews required by the big engines now being produced has disturbed designers very considerably, but the increasing size of aircraft tends to offset disadvantages.

In the case of multi-engined aircraft there are various ways of reducing the distance from the centre line of the aircraft to the outboard airscrews, i.e., gearing two or more engines to a common shaft or employing double concentric airscrews. The first expedient results in large airscrew diameter and great weight, whereas the double concentric arrangement gives minimum diameter and less weight, though the take-off thrust is seriously impaired because of





The Curtiss concern has developed the four-bladed v.p. airscrew (above) to increase the effective blade area, permitting efficient absorption of power for engines of increasingly high output by airscrews of smaller diameter. On the right is the new hub-section of the Fairey "Contra" counter rotating airscrew combination.



A Junkers airscrew on a Jumo 211 engine showing how it can be completely feathered in flight.

the inadequate disc area. Accordingly, it has been suggested that the most efficient arrangement is a single airscrew of adequate diameter for each engine.

Lighter blades such as those of impregnated and compressed wood will reduce enormously centrifugal loads on the hub and will assist greatly in reducing the gyroscopic force of the airscrew, thereby relieving the airscrew shaft. Possibly it may be found in the future that for really high powers recourse will have to be made to the gyroplane principle of hinged blades which would bring about the disappearance of the gyroscopic force. A step in this direction has been made with the Everel single-blade airscrew. The idea of the single blade was first conceived because of the loss of efficiency resulting from disturbed air left behind a rotating blade.

Reversible Pitch

Reversible pitch as now introduced on certain types of airscrew permits incomparably easier manœuvre by marine aircraft and may also be applied for reducing the diving speed of dive-bombers. The majority of up-to-date variable-pitch types are, in any case, of the full-feathering variety; full-feathering means that the blades can be turned edge-on to the line of flight, so that in the event of an engine cutting out the drag may be much reduced and performance on the remaining power plant much improved.

One of the most popular types of modern airscrew is the Hydromatic as designed by the American Hamilton concern and manufactured in this country by De Havilland. The pitch control mechanism of the Hydromatic is of the hydraulic type, though it differs somewhat in application from the system used on the earlier constant-speed airscrews. One of the reasons for this is the additional safety problem introduced as the result of the feathering feature, for airscrews in the feathered position will not carry out the normal propulsive function and would obviously be dangerous if they could be feathered inadvertently. Consequently, it is necessary to provide some means of restricting the pitch range during normal operation so that the blades cannot be feathered except by a deliberate action on the part of the pilot.

A design increasing in popularity in this country is the Rotol, which, whether of the feathering or non-feathering type, comprises essentially an hydraulic cylinder to which the airscrew blades are connected by pins or links and a fixed piston carried upon a sleeve member extending through the cylinder.

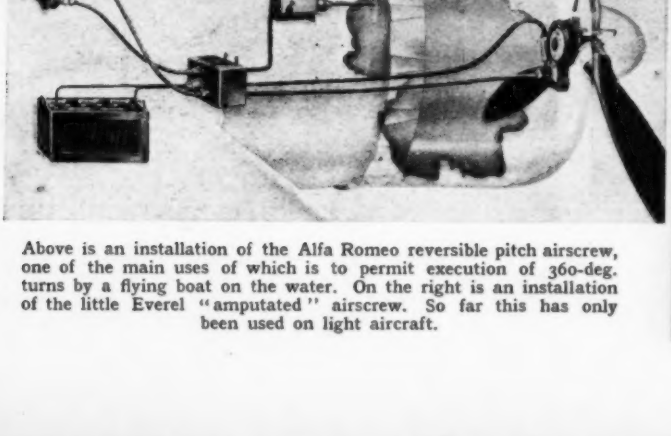
Another successful type is the Curtiss electric full-feathering model designed for constant-speed operation as well as manually selected control and feathering.

Detailed information on counter rotating airscrews is scarce, but we may refer to the Fairey "Contra" type which consists of two three-bladed fully-feathering constant-speed airscrews revolving in opposite directions.

In this country the greater interest has been shown in methods of blade manufacture rather than the design of pitch-changing mechanism. For example, there is the Jablo (Heine) system in which a synthetic resin is used for cementing the wooden laminations together. Another resin is sprayed over the surface and while this is still "tacky," a steel gauze, covering the outer three-quarters of the blade, is applied. When this synthetic resin is set a narrow strip of brass is soldered to the gauze along the leading edge and the whole is covered with glaze.

Hordern-Richmond Aircraft use the B.T.H. process which consists of a synthetic resin-impregnated fabric covering. The company is also devoting its attentions to suitable material and has done a great deal of work on laminated wood, compressed and bonded with various plastic materials. De Havillands have developed solid and hollow blades of synthetic resin. Solid blades have been machined from the block, one of the more successful materials being Bakelite re-inforced with special fabric. Interesting comparative experiments were carried out with woods compressed and impregnated with resin and hollow blades moulded in Bakelite and reinforced with cord.

Very great credit is due to the Airscrew Company for their work in adapting wooden blades to variable-pitch hubs. Blade roots are made of compressed wood while the blade itself, not being subject to such high local stresses, is of ordinary light wood with Schwarz finish.



Above is an installation of the Alfa Romeo reversible pitch airscrew, one of the main uses of which is to permit execution of 360-deg. turns by a flying boat on the water. On the right is an installation of the little Everel "amputated" airscrew. So far this has only been used on light aircraft.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

FLYING IN 1908

Sir Alliott Verdon-Roe States his Case

I AM extremely sorry to take up any more space in your columns, especially when there are so many more important matters to deal with, but I cannot allow Lt. Col. Moore-Brabazon's accusations, in *Flight* of January 18th, 1940, to pass unanswered. By intentionally omitting certain facts, he has attempted to prove my claim to have flown in 1908 to be entirely unjustified. This not only reflects on me, but the witnesses as well. When these facts are considered, my letters to Wilbur Wright and *Flight* do not appear to be so curious as he would have your readers believe.

After receiving the 24 h.p. Antoinette engine, I removed the 9 h.p. J.A.P. and made no further towing flights. I had six trials in all with this engine, and on each of these occassions I generally made several attempts. About four of these six trials were made by myself in the early hours of the morning, as I had to be off the track by 10 o'clock. There is no doubt that on several occasions, not only did the front wheels come off the ground, but the rear ones as well. But it was very difficult for me to see or feel when my machine was clear, as the rear wheels were several feet behind me and well sprung. Consequently they were not visible without turning round, which I hardly dare do. I think it was quite possible that I did over 100 feet on one occasion. According to one witness, he considered I did about 150 feet.

The Wright Letter

As regards my letter to Wilbur Wright, it should be borne in mind that I was writing to someone who had flown miles. He was hardly likely to be interested in details about some hops or short flights, and therefore I merely stated in my letter to him that I was fast making progress when I had to leave. I also mentioned the towed flights, these being a novel method and probably the first towed flights in the world.

Moore-Brabazon says that Rodakowsky would have kept me on the track as a "draw," if I had even been making hops by running down the 1 in 13 slope. That was about the last thing in the world Rodakowsky would have done. The incident of having my machine taken from the corner of the paddock proves that. I lent my shed to be used as a restaurant on race days. When Rodakowsky saw my machine in the unused corner on Bank Holiday, he said to me, "Why is that machine there?" I asked him "Where else could I put it?" He promptly called some attendants and ordered them to lift it over the railings. Not satisfied with that, he bawled to them to take it farther back and farther back, until they came to a dyke, which he told them to cross. In doing so the machine was damaged. Rodakowsky said he was sick of seeing photographs of me in the Press, and that Brooklands was a motor track not a flying ground.

C. G. B.

As regards my letter to *Flight* concerning my second machine. I was beginning to have more respect for even 50-ft. hops or short flights. The reason why, when I first attempted to fly this machine, it covered such short distances, was due to the c.g. being too far back, owing to miscalculating the tailplane's lifting capacity. Being half the area of the main planes, I thought the lift would be about half that of the main planes, not realising the adverse effect of down draught. It was, I am sure, much easier to do 100 feet on my original machine than 50 feet on my second one, as the c.g. was just about right on my Brooklands machine, which had been stepped up from my successful "Daily Mail" model. Also, the towing flights had proved that the c.g. was satisfactory and little power was required. If my memory serves me correctly, I think a 6 h.p. car towed me into the air on one of the early trials. Although my second machine was a big advance on the first, as regards general and detail design it was not such a good flying machine, neither was it capable of taking such heavy landings as my Brooklands machine could do without damage.

One member of the Committee suggested I had used the 1 in 13 slope, but I pointed out it was at the Vickers end of the finishing straight that the witnesses saw me leave the ground, and in that case the slope could not have helped me.

According to the Stress Department of Saunders-Roe, Ltd., the Brooklands aeroplane could not have done 70 feet without flying. Even allowing for 100 per cent. exaggeration by one of the witnesses, the machine must have flown. In view of the serious nature of Moore-Brabazon's accusations, I consider he should have a duplicate machine made as soon as the present war is over. I shall be pleased to make the attempts.

A. VERDON-ROE.

Hamble.

HELP FOR FINLAND

Why Not Send Gladiators?

SELDOM have the British peoples been so profoundly moved as they now find themselves over the heroic resistance of Finland to Russian aggression. We are informed that substantial help is being sent to the Finns by both Britain and France. Whatever that help may be, it is painfully clear that it is hopelessly inadequate.

Moscow warns us to keep out of the Finnish war, or it will be disastrous for us. Russia is going to "liberate" the Finnish people from the imperialist yoke. Russia is going to do all this without so much as a by your leave. In plain words, the British are told to stand by and condone mass murder or mutilation of a gallant people.

Unless the mind of man be hopelessly distorted, he cannot but be galvanised into some form of activity on behalf of Finland.

Can we spare fighting planes for Finland? Would it be wise to send Supermarine "Spitfires"? Should we send pilots?

To the second and third questions, the answer is a reluctant no. We cannot afford to run the risk of our eight-gun fighters falling into the hands of the Russians. We want every pilot we can lay hands on.

At the same time we must have numbers of "Gladiators" that are continually being replaced by our newer types, superb fighting machines, but too slow to catch a modern German bomber. These very manœuvrable fighters, manned by Finnish and Polish pilots, would at least give Finland a chance to protect her civil population from a fate too terrible to bear contemplation.

London, N.W.3. JOHN W. MORRISON.

[Our correspondent will be glad to know that there *are* Gladiators in Finland.—ED.]

ESCORT FIGHTERS

The Contra-prop Scheme

REFERRING once more to this question of contra-props for escort fighters. In your editorial comments (January 25, 1940) you suggested that (A) contra-props means added weight, (B) that shaft drives be used to props located on the wing structure.

(A) If the engines are installed in the fuselage in tandem the engine mounting should weigh less than the engine mountings for two separate engines.

The forward engine would need modifying in the following manner: The supercharger would have to be moved to the side or top of the engine and driven by a right-angle drive from the crankshaft. A tubular splined shaft would be used to mount the prop (rear) and the necessary mods. made to the forward casing.

The rear engine would be standard in every respect and would drive a shaft which would pass between the cylinder banks of the forward engine and through the tubular splined shaft to the forward prop.

All of this is fairly straightforward, and note how short the shaft would be.

(B) To mount the props on the wing structure and drive through shafting and gearing means not only considerable extra weight, but also loss of power through the gears. Also you have overlooked the fact that contra-props are slightly more efficient than separate props (it has been quoted that, giving a 1,000 b.h.p. engine, with 11.1 dia. prop, the gain should be about 1.4 per cent., due to the rear prop gaining extra thrust from the slipstream of the forward prop).

Also, two of the great advantages of contra-props is that the twist is practically removed from the slipstream and torque is balanced out.

Looking at it from the point of view of the middle gunner, contra-props do not restrict his field of fire nearly so much as a normal twin-engine arrangement.

It must not be overlooked that any aircraft is a com-

promise, that an escort fighter must have speed considerably in excess of the bombers it is escorting and, if possible, equal to or greater than that of the opposing fighters. It must have a range equal to that of the bombers; it must present the minimum target area; and it must have the greatest possible fire power consistent with performance, and have minimum crew.

Hence tandem engines and contra-props, guns in the wings for the pilot, a middle gunner in a power-driven retractable turret and a power-driven tail turret. Obviously such an aircraft would also make an excellent reconnaissance machine or small bomber.

Too many aircraft have a blind spot under the tail, as has been amply proved already, and some designers (and the A.M.) do not yet seem to realise that this is a point where aerodynamic fineness should be sacrificed to fire power.

Southampton. COLIN R. BARTY.

MOTORLESS FLIGHT

A Power Pilot's Views

IN support of the many interesting letters I have read regarding the value of motorless flight as a sound basic flying training, I offer my own experiences.

I will take you back to 1929 in Australia, when I purchased a Farman biplane with a none too reliable Anzani engine. Not being able to fly myself, I engaged a pilot and we went barnstorming. This finished up with my Farman sitting on a fence bordering a small field and completely falling into fragments. Except for the carburettor the engine was undamaged, but the airframe was beyond repair.

Undaunted, I constructed from the top wing and empennage a primary type glider. I had seen pictures of gliders the Germans were using, and with a little imagination I built up a contraption resembling them, but with an undercarriage in addition to the conventional skid. This took me exactly six weeks. Now, although I was keen to fly, I thought it best to get an experienced pilot to try this thing out; but could I get one? Not on your life!

In the approved pioneer spirit, so to speak, or rather a case of fools stepping where angels fear to tread, I hitched myself to the seat (I had a mental picture of the witch sitting on a broomstick!) and, with the aid of a 12 h.p. car, careered madly across the aerodrome.

After numerous unsuccessful attempts to rise, I decided a more powerful car was required. These unsuccessful trials, however, were really my salvation, because I learnt to press the right foot to turn right and left foot to turn left, etc. This I found very difficult at first, having spent most of my youth on kiddies' carts, which were steered by placing one's feet on the front axle. This, of course, is the reverse to flying. The joystick action came quite naturally.

Having made arrangements for the use of a 30 h.p. car, I again set out for the test flight. After a very short run I was hurled skywards at a terrific rate, and, of course, pulled and pushed everything at the same time; and was I scared—or was I?

I went to the top of the rope about 100 feet up, pulled the trip gear and glided to earth without smashing anything. I made five more successful flights that morning. I came to the conclusion the c.g. position was too far back as I couldn't get the tail up properly. During the coming week I shifted the seat forward a couple of inches.

Great publicity was given to my experiments, and a demonstration was arranged for the following Saturday afternoon. On that day 6,000 people visited Eagle Farm Aerodrome to see the fun.

Cross-wind Start

The local barnstorming boys took advantage of the crowd, and the money rolled in, but when I asked them to hold off for my flights, they refused and told me to fly on the other portion of the field, which was slightly cross-wind..

In my ignorance I tried this. The *Golden Sparrow*, as my contraption was called, went to the top of the rope all right, but when released it went into a side-slip. I put the nose down for more speed; it went down all right and stayed down. Result—a side-slipping dive into the deck. Fortunately, I had a lap strap and chest strap which saved my life. The whole kite collapsed around me.

I struggled out without a scratch, but I had a stiff neck for about a week as a result of my head flicking forward during the sudden stop. I reckon I hit the deck at about 60 m.p.h. as the car was travelling at 50 m.p.h. when I tripped off.

This put a stop to my activities for about six months, and I swore I would not fly again. I sold the remains of the 'plane and glider to a pal, who commenced to build up a secondary type glider with the fuselage and three of the Farman wings, making a span of about 37ft. 6in. The *Golden Sparrow* was only 25ft.

He experienced the same difficulty with the rudder as I did, and finally asked me to fly the glider for him. By this time I had forgotten the crash and merrily jumped into the cockpit. The machine flew reasonably well and I made a number of successful flights.

I later designed an orthodox training glider, sold the designs, kits of material, etc., to clubs, and generally classed myself as a gliding expert.

I visited country centres, organised clubs, gave lectures and gliding demonstrations. During this time I was gradually becoming "power" minded again, so set to work to design and build the original "Wicko," which was a one-place high-wing cabin monoplane.

I fitted a new carburettor to the Anzani and used that engine in the "Wicko." Having learnt a lesson, I did not test-fly the "Wicko," but on this occasion managed to secure the services of a competent pilot.

I then managed to get in some dual instruction in D.H. Moths at intervals during the next few months, amounting in all to a total of 1 hour 40 minutes.

On Anzac Day, 1931 (anniversary of landing of Australian and N.Z. Army Corps at Gallipoli), I went to the aerodrome and warmed up my engine in preparation for my first power flight.

I asked my instructor if he thought I would be O.K. He happened to be an old Anzac and was a few sheets in the wind at the time. All he said was: "Well, it's your neck and your machine." Forthwith I jumped in, gave her the gun and made my first solo flight. I did one circuit and landed. I was so frightened when I got out I could hardly walk, but this didn't prevent me from reaching the bar!!! My instructor's remarks were: "The spirit of Anzac is not dead yet."

You may gather from this narrative that gliding experience is of definite value towards power flying. The facts are: 1 hr. 40 min. dual in an open-cockpit biplane; first solo in a high-wing cabin monoplane.

I might say I still enjoy throwing a machine about with the throttle closed, and on one occasion some years ago I looped a D.H. Moth three times in succession with the engine off. This required a diving speed of over 140 m.p.h. and a very tight loop.

I strongly advise enthusiasts not to try this, as their luck may not hold out as mine did. G. N. WIKNER.

Southampton.

HELP THE AIR CADETS

Aircraft Parts Wanted

THE Squadron of Air Cadets at this school is in urgent need of aeroplane parts, a fuselage or any instruments. The work of the Cadet Corps is well known and I think requires no emphasis from me.

If any of your readers have any equipment for which they have no further use, we would be very glad indeed to have it, and I could assure them that it would be put to a good use.

Model aeroplanes of any kind or literature of any kind would also be welcomed.

C. F. F. GIBBS, Commanding Officer,
Air Defence Cadet Corps,
No. 133 (Minehead County School) Squadron, Somerset.

ROCKET EFFICIENCY

Dr. Lanchester Takes "Flight" to Task

IN your issue of February 1 (just to hand), I find two glaring mistakes in the Figures 3a and 4. In the first of these I find the expression $\sqrt{2 \times V}$ which should read $\sqrt{2} \times V$, and in Fig. 4 I find—

$$v = \frac{\sqrt{2p}}{\rho} \quad \text{instead of} \quad v = \sqrt{\frac{2p}{\rho}}$$

I should be glad if you will make it clear that I am not to blame for this because (1) I specially requested that the blocks should be made from my drawings as sent in and not redrawn; and (2) that you did not submit pulls of the blocks to me although my drawings were in your hands on January the 8th. Furthermore, in the explanatory footnote at the bottom of col. 2, p. 98, and in the 14th line from the top of that column, the expression is correctly given. I hope there are no other mistakes which I may have overlooked, but with the above warning readers may be on their guard.

F. W. LANCHESTER.

[We much regret the slip and hasten to publish this explanation.—ED.]

UNDERCARRIAGES

Review of Present Types : How They Developed : Will Tailwheels Disappear? : Design in the Future

By BRUCE FOSTER, B.C.E., D.I.C., A.F.R.Ae.S.

The Douglas DB 7 bomber exemplifies the American practice of equipping new military types with the nosewheel.

THERE is nothing new under the sun, and this holds in the world of aeronautics. When the Airspeed Courier appeared in 1933, and the age of retractable undercarriages started in earnest in England, it was thought by many people that something absolutely new had been designed. But way back in 1918, James V. Martin, an American pilot-designer well known at Hendon, flew his little Martin K.111 single-seater biplane with a backward-retracting undercarriage of such narrow track that the wheels fitted snugly against the sides of the fuselage. There was also a Bristol monoplane in the 1920's, and maybe historically-minded readers will be able to find earlier examples, particularly if they do not confine themselves to designs which have flown.

It looks as though the year 1939 may stand out in aeronautical history as marking the start of the "nosewheel era" in landing gears. ("Tricycle" is not a good name for describing this latest in undercarriage design, as it merely means three-wheeled, and the tailwheel type is just as much three-wheeled. "Nosewheel" and "tailwheel" do, however, distinguish them as different undercarriages.)

Old Types

But we have not arrived at the new era without going through a progressive development. The retractable design of 1918 did not hold its place owing to extra weight and complication, and fixed undercarriages prevailed for more than a decade later. The designers of the early fixed undercarriages were concerned quite a lot about nosing over. That veteran, the original Avro 504, had a wooden "toothpick" pointing forward and looked like an old-time knight with lance held at the charge. And there was a deck-landing type which carried, forward of its undercarriage, a small planing surface which was intended to prevent a somersault if forced down on the water. The little known Dunne tailless aeroplane has no niche in the hall of fame, but will be remembered by some people at Eastchurch for the fact that its undercarriage had twenty-seven members in it. If the "thrush test" had been applied, perhaps it would not have got its C. of A.!

In Process of Development

But since then the desire for speed has cleaned up undercarriages, and the Moth divided type with just three struts to each wheel was an advance. Wheel "spats" helped further, but "pants" fairing in the whole structure went one better still, and the DH 86 with wheel immediately below and faired into the engine nacelle was an example of a fixed undercarriage with not too much drag. A later example is the Martin-Baker fighter.

The retractable undercarriage was, however, already with us at this stage, 1934, and became part of design formulæ for anything faster than about 160 m.p.h. But an outstanding example of one of the last of the fixed type on military aircraft is the single-leg undercarriage on the Gloster Gladiator, with the ingenious Dowty internally-sprung wheel.

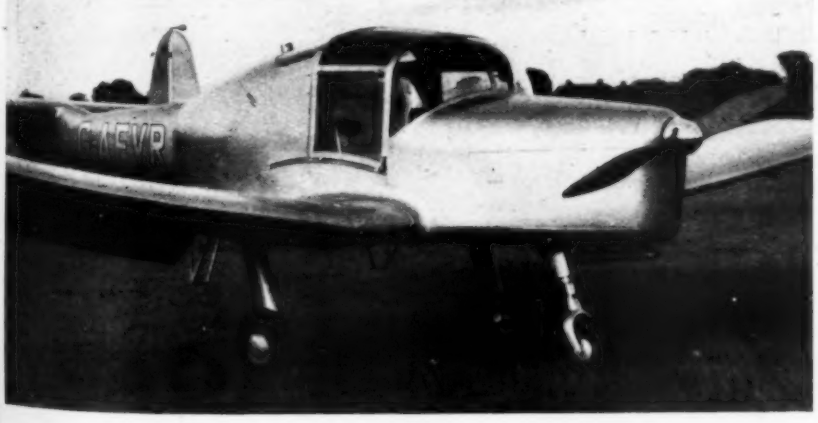
Nosewheel undercarriages are as yet conspicuous by their absence from British military designs. Primarily a development in civil design, it has been taken up for military types also on the other side of the Atlantic. The Douglas bomber, DB 7, and a speedy twin-engined Lockheed pursuit, XP 38, with twin tail-booms, are two of the numerous examples. The Douglas DC 4 and the new Consolidated four-engined bomber are two of the biggest tricycle designs. Emphasis in this country has been placed more on getting existing types into enormous production rather than on developing new types, but this latter will come in the near future and doubtless nosewheel types will then be well represented.

Nosewheel Advantages

Advantages of the nosewheel type of design include:

(1) Greatly reduced tendency to bounce if the aeroplane is glided on to the ground, so simplifying landing.

(2) Better controllability on the ground in cross-wind landing and taxying.



The Cygnet landing gear has been changed by the General Aircraft designers from the tailwheel design to this fixed nosewheel type.

UNDERCARRIAGES (CONTINUED)

The planing bottom of the Saro Lerwick shows how gradual changes as the result of experience have reduced the drag of flying boat hulls while still retaining good hydrodynamic properties.

(3) Better vision for the pilot in the take-off.
(4) Less drag in the first part of the take-off run.
(5) More convenience for passengers getting in and out, as the cabin floor is horizontal.

The General Aircraft Cygnet is equipped with a nose-wheel and is a very useful civil two-seater. Being a training and private-owner type, its speed is not sufficiently high to warrant retraction. People who have flown this machine are enthusiastic about the improvement in handling qualities caused by the change from the tailwheel undercarriage which the type had when first produced.

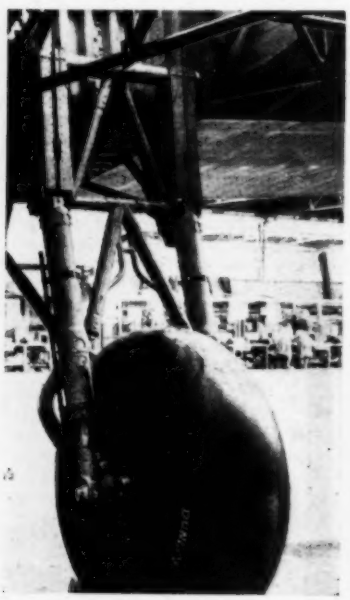
It is significant that the big Fairey civil airliner project, the FC1, which has had to be temporarily abandoned so that wartime activities may proceed, has a nosewheel. It is hoped that civil developments such as these will not be delayed for too long, so handicapping Britain in the world of civil aviation.

Another type of landing gear which has a third wheel behind the two main wheels cannot be passed over without comment. Designed by British Landing Gears, Ltd., it has been flown experimentally. An idea which has been proposed but not developed is to have all the landing wheels steerable so that in a cross-wind landing they may take up the correct alignment. This design is known as the Maclaren "crabbing" undercarriage. While no doubt this is desirable, it can only be obtained by greatly increased complication, weight and perhaps cost. Its future does not appear bright.

Of the current fighter types, the Hawker Hurricane is an example of sideways and inwards retraction, while the Spitfire's designer has chosen to stow its wheels away by an outwards and sideways movement. Sideways retraction is usually adopted for single-engined types and for aircraft whose wing section is not very thick. The four-engined DH Albatross is an example of this. Its comparatively small nacelles on a thin wing do not lend themselves to the vertical accommodation of a wheel, so they have been retracted in a very clean manner by a sideways and inwards movement.

Back to Hydraulic?

The Albatross is one of the few examples of electric retraction. The hydraulic method is overwhelmingly popular in the design office. Electric retraction was more



The movement of the Whitley wheel is almost vertical as it is retracted into the nacelle by the "breaking" of the main struts. Doors close after it and reduce drag.

The retraction of a very large undercarriage into a high wing has been successfully solved in the Armstrong Whitworth Ensign. Note the cables of the emergency hand-lowering system.

The DH Flamingo, latest civil airliner, is an example of backward retraction into the engine nacelle. Its Lockheed undercarriage is retracted by Dowty hydraulic gear.

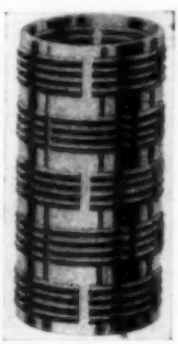
UNDERCARRIAGES (CONTINUED)

The alighting gear of this Curtiss observation seaplane shows the American tendency towards a single float.

in favour on the other side of the Atlantic, but the latest Lockheed to appear, the Lodestar, has adopted the hydraulic system. The latest De Havilland, too, the Flamingo airliner, is also hydraulic, having its Lockheed cantilever undercarriage retracted backwards into the engine nacelle by Dowty hydraulic gear.

There is, of course, always an emergency means of operation. In the case of hydraulic mechanism an emergency hand pump is provided as a reserve for the engine-driven pump, and a hand-operated mechanism for putting the wheels down is an additional standby in case of trouble.

Retractable tailwheels have never been adopted generally anywhere in the world. A comparatively small disturbance to the streamlined form, it has not been thought worth while by most designers to arrange for its retraction and so add a little more weight and complication to an already formidable list. The American Curtiss-Wright Substratosphere Transport is an overseas exception—it has not adopted the nosewheel and has its tailwheel retractable. The Hawker Henley target-tower and the Bristol Beaufort are notable exceptions, looking very clean with everything tucked away.



The Lockheed spring roller bearing to reduce friction between the telescopic tubes of shock-absorbing struts.

The Westland Lysander is an interesting example of a modern military type with fixed undercarriage. Built for army co-operation duties, its high monoplane wing, giving the pilot excellent view, makes the problem of retraction a structurally difficult one, and its comparatively low speed makes undercarriage drag not so important. Consequently, Dowty internally-sprung wheels, efficiently faired by "spats," have been used. The Bristol Bombay is a larger example of a high-wing monoplane with fixed undercarriage.

If this article were to deal with the mechanical details of undercarriages, the materials used in their hundreds of parts and to discuss fully the whys and wherefors of the different systems—backwards, sideways and forwards; electric or hydraulic—a book would be required. For on no other part of the aeroplane is there such scope for engineering ingenuity and no other part can boast of so many ways of achieving the desired result of pulling the landing wheels in out of the airstream, a result which Nature appears to do so easily in the case of the bird. Man's corresponding effort with the aeroplane appears more complicated at a first comparison—but after all, is it? Perhaps a diagram of the muscles, blood-vessels and nerves controlling a seagull's legs would be even more intricate than the plumbing of a modern hydraulic undercarriage.

In just touching on the details of landing gears, the shock-absorbing strut is perhaps the most important member. The principle of one ingenious design, the Lockheed "Airdraulic," combines the elasticity of air for taking the shock with the damping property of a liquid. The fluid, a special oil made up to have correct viscous, non-freezing and non-corrosive properties, is in the upper part of the strut and is separated from the air in the lower part by a floating piston.

As the strut is compressed the volume of the air space is reduced and the air compressed, so providing a resisting force proportional to deflection. The main piston moves upwards through the liquid, which is caused to flow easily through comparatively large radial holes. On the return stroke the fluid starts to flow in the reverse direction and causes a flutter plate to close the radial holes. Only a small central choke orifice remains, and this so restricts the flow of the liquid that the speed of return of the strut is reduced and rebound prevented.

The design of undercarriages is

On the left is the Spitfire undercarriage. This Vickers cantilever oleo-pneumatic shock-absorber leg is retracted outwardly by hydraulic means.

The DH Albatross undercarriage works by electrical retraction sideways and inwards into deep wheel wells.

UNDERCARRIAGES (CONTINUED)

Dowty internally-sprung wheels allow this very clean single-leg undercarriage to be used on the Gloster Gladiator.

(Right). The Martin-Baker fighter is an example of a well-faired "trousered" type of landing gear.

such a vast subject that its complexity and many-sidedness has led to the establishment of a firm specialising in this work, Aircraft Components, Ltd. With this firm the name of Dowty has become inseparably linked as the designer of components or of whole undercarriage units which the firm supplies to many of the aircraft factories. The Dowty "nutcracker" undercarriage is a neat design with two hydraulic jacks on the retracting strut. As pressure is applied to these they lengthen, and, breaking the strut at its central pin-joint, rotate the undercarriage and so pull it up into the wing.

Latest of the components to be developed under Dowty design is a shock-absorbing strut of unorthodox appearance referred to as "Levered Suspension." And the new "Live-Line" engine-driven pump maintaining full pressure in hydraulic lines even at zero delivery has been added to the firm's range.

To reduce friction between the telescopic tubes of shock-absorber struts and so reduce sticking and wear, a Lockheed design of roller bearing has been evolved. A tubular sleeve between the two telescoping tubes carries, circumferentially set into slots cut in the sleeve, a series of coiled spiral spring rollers. These act as the balls of a ball-bearing and the sleeve is the cage. Unlike the solid ball, the spring is stressed in bending by compression across its diameter and so must be made of a deep-section flat strip to resist the load. Under load the spring roller is compressed to an oval shape and so increases its bearing area and reduces the load concentration. Hardening of the bearing surfaces is not necessary.

All Lockheed designs are produced by the Automotive Products Company, Ltd., and this company, too, produces complete undercarriage installations ready for attachment to air frames. A notable undercarriage with Lockheed hydraulic equipment is that on the Armstrong Whitworth Ensign. The combination of high-wing monoplane and retractable undercarriage has caused it to be the largest such unit in the world. With wheels of over 6ft. diameter there are two hydraulic jacks per wheel, and these are each 7ft. long when extended and can exert a maximum thrust of six tons.

The accessories belonging to hydraulic undercarriage systems are too numerous to more than mention. There are engine or electrically driven pumps, hand pumps for emergency operation, selector valves, emergency selector valves, flow control valves, position indicators for the dashboard and even interlocking mechanisms between the undercarriage and its door.

At the mention of the word undercarriages one is apt to think only of wheels. But there are at least three other types. Skis are used in countries such as Canada and in parts of U.S.A. where snowfalls may be so heavy that aerodromes cannot be kept clear. And floats of seaplanes are another form of alighting gear on which much ingenuity of design has been expended. The provision of stability on the water by avoidance of "porpoising" makes design difficult, as this consideration has to be added to those of low hydrodynamic and aerodynamic drag. In this country the single float has never been adopted, but this type, with wingtip floats for stability, has been seen on several American designs. The Curtiss scout observation has the long float attached as a cantilever on a single pedestal.

The German Ha 140, made by Blohm and Voss, is an example of a very large floatplane, and it also has the single pedestal floats giving a very clean appearance.

The third form of alighting gear is the planing bottom of the flying boat. Flying boat hull design has undergone progressive changes—and they are still occurring. The shape and location of the steps on the planing bottom is not susceptible to treatment by formula—model tank tests and subsequent full-scale behaviour are what the designer goes upon, and he must make his changes cautiously. So we see in flying boat design a state of gradual but continuous change. The vertical step is giving way to a shape less abrupt, and hull shape, with the rear step nearer the tail and pointed in plan form, is now combining less aerodynamic resistance with good hydrodynamic properties.

The Future

Just as there is nothing new under the sun, so is the last word never said on any subject. Developments in landing gears will occur in the future, but they may not be spectacular. Simplification below three points of support is manifestly impossible, and improvements in materials will not cause spectacular changes. But the nosewheel design is here to stay and is going to be helpful in landing aircraft in conditions of bad visibility, or at night when it may be hard to tell just where the ground is. In such conditions a nosewheel aeroplane can be practically glided on to the ground without harm instead of having to be stalled just a foot or two above it. And increased shock-absorption characteristics will, of course, help very much. Air transport strives always towards 100 per cent. adherence to schedules, and instrument-landing will become a regular feature of airline operations to this end. It is going to aid instrument-landing if the pilot is helped by a long-travel undercarriage which will take without complaint, if called upon to do so, a somewhat more vigorous contact than usual with the earth. Such a development would have its applications in military as well as civil work.

"ELEKTRON" TANKS

Some Notes on Their Design and Construction

THERE is in most people's minds a general impression that light alloys with high magnesium content suffer from several drawbacks. Not least among these is the belief that the material is very apt to catch fire during machining operations. Thoughts of the high magnesium content in incendiary bombs, and of the flash powder used by photographers, are probably responsible for this impression—a very natural one. There is also a tendency to regard magnesium alloys as having rather low mechanical strength, and to fear "creeping" around machining areas. Old beliefs die hard. The high magnesium content alloys produced some 12 to 14 years ago justified this distrust, but since those days considerable progress has been made, and the proof stress and ultimate tensile strengths have now been much improved.

The very coarse matrix met with in the machining of weldable castings and forgings tends to create an unfavourable impression, but is actually not detrimental, and does not detract from the mechanical strength of the material, or from the working qualities.

The following comparison may be of interest:—

Specification DTD 118: Ultimate Stress 12-15 tons/sq. in. Proof Stress 6-8

Specification 3.L.1. 25 tons Ultimate; 15 tons Proof.

Specification L.16. 7-8.5 tons Ultimate.

It is expected that an improvement in the proof stress will be attained very shortly. As will be seen, DTD 118 has a proof stress value approximately equal to the ultimate

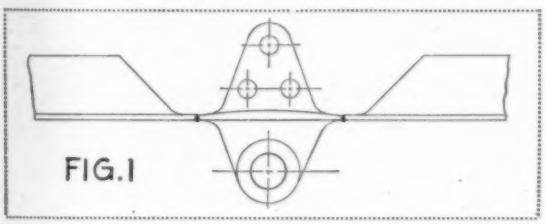


FIG. 1

value of L.16. The latter material can be used for comparing the manipulating qualities of DTD 118, which is 30-40 per cent. lighter than L.16 and almost two-thirds lighter than 3.L.1.

In the early days the low resistance to corrosion was a serious problem. The corrosion resistance factor of modern "Elektron" has been improved a great deal since the material has been manufactured in this country. (The first supplies came from Germany). The plant for obviating corrosion during working to-day is of the simplest, and suitable protective paints are now available.

Tanks constructed in "Elektron" magnesium alloy offer not inconsiderable advantages to designers:—

(1) Versatility of design in regard to shape, method of mounting and incorporation of fittings; (2) Lightness; (3) Resistance to fatigue; (4) Simplification of construction, due to the use of heavier gauge, which gives a stiffer shell without additional reinforcement; (5) Ease of repair.

The design of magnesium alloy tanks should not be based on the practice common to aluminium, aluminium alloys, steel or brass. The following rules should always be followed: (a) "Elektron" tank shells must be welded and not riveted; (b) All welds should be butt welds; (c) All welds should be beaten and positioned to allow for this process. Thus corner welds are to be avoided, and where a welded-in "T" section is interrupted the web should be cut away .2in. clear of the end of the flange (Fig. 1); (d) Fittings, such as sumps, fillers, webs, inlet connections, etc., should be either welded direct to the shell or bolted to adaptors which are welded to the shell (Fig. 2).

(e) When water is present in T.E.L. fuel it will attack magnesium. Accordingly, a bag containing a mixture of chromate salts is incorporated in magnesium alloy fuel tanks. These bags are usually placed in cages of MG7 (or similar alloy), which may be screwed into an adaptor (Fig. 3). The chromate mixture dissolves in the water and renders it inactive while not affecting the fuel. Water is heavier than normal fuels and it is essential that the inhibitor be so positioned that water is free to gravitate to it from all parts of the tank when the aircraft is on the ground. Pockets caused by fittings bolted to adaptors on the bottom of the tank, and similar obstructions, must be avoided, and holes should be drilled at the root of the T-section webs. If free access of water to an inhibitor is doubtful, more than one inhibitor should be incorporated. As a general rule 1 oz. of salts, renewable annually, should be provided for every 100 gallons capacity.

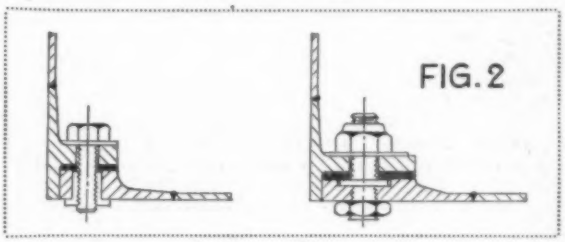


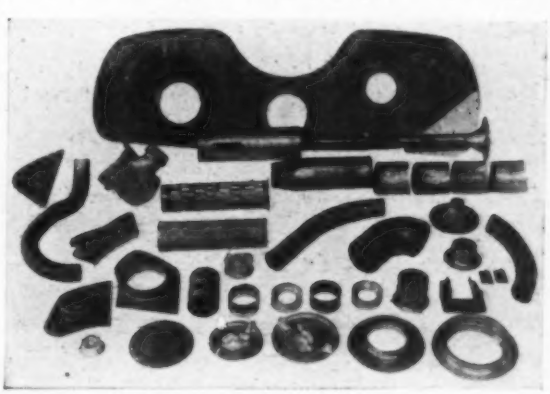
FIG. 2

(f) Special care should be taken in the selection of the magnesium alloy. For tank shells, material corresponding to DTD 118 ("Elektron" AM 503) is one such alloy which can at present be satisfactorily used for the purpose, owing to its good welding and forming properties.

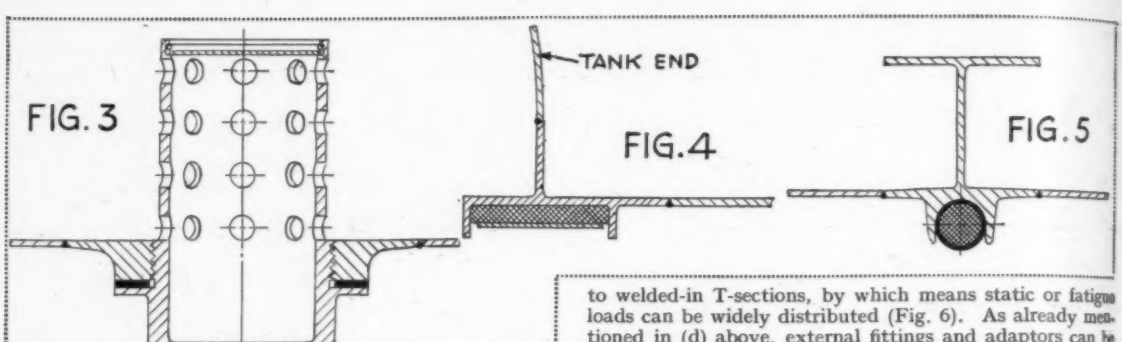
(g) Extruded and cast parts which are to be welded into the shell must be of the same alloy as the tank sheet, i.e., "Elektron" AM 503. Extruded materials to this specification are covered by DTD 142 and casting by DTD 140A.

(h) The tank should be designed in such a way that distortion due to welding can be accommodated *in all directions* and subsequently corrected. This is *important* in deciding the sequence of constructional operations, and particularly in the case of the final weld seam.

Thus, in the case of a tank incorporating baffles attached to a T-section, viz., where the flange of the sections is welded to the shell, it would be unsatisfactory to fix the baffle to the web of the T prior to welding to the shell, as the frame thus obtained would be rigid in the plane of the baffle. Distortion thus caused can influence the shape of a tank to a great extent. The common procedure is to weld the T-section to the adjacent sheet, adjust distortion and beat seam, and finally attach the baffle. In general, the shell can be considered rigid to a distance of

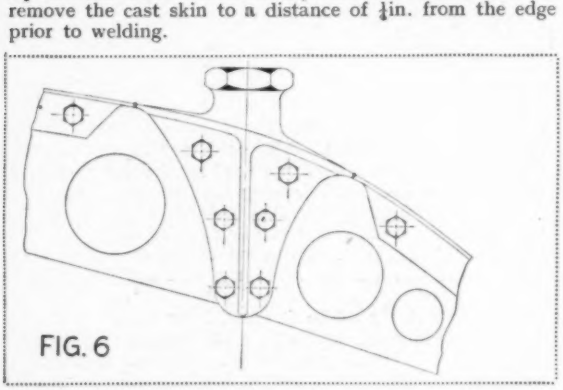


Not so complicated as it looks. These many pieces of an "Elektron" tank are subsequently welded together to form larger units.



six to seven inches from the frame, at which point its flexibility would no longer cause difficulty. This should be borne in mind when considering the closing seam.

Material to DTD 140A is not easy to cast to intricate forms, so that reasonable simplification and smooth change of section should be the designers' aim. Minimum web thickness for castings is from .125in.-.15in.; therefore, when welded contact is made with sheet skin, the casting edge must be bevelled to the required thickness. Apart from this it is necessary, for weld cleanliness, to remove the cast skin to a distance of ¼in. from the edge prior to welding.



(j) In the case of aluminium alloy tanks in which there are heavy filler necks, or connections to large unsupported panels, it is usual to reinforce locally with a riveted star plate. In the case of magnesium alloy tanks, however, such a reinforcement should take the form of a circular disc of sheet, of a thicker gauge than the panel sheet, butt welded to the shell. A star plate is difficult to weld, due to the number of directional changes of the seam and consequent necessity for numerous welding stops and starts. This should be regarded as a principle in design, as flux inclusions are more likely to occur at points where welding has been interrupted.

On account of the exceptional welding qualities of the metal, magnesium alloy tanks may not only be designed to any shape possible in the de Bergue riveted or welded aluminium types but also to requirements not possible with either of these types. For example, if it is necessary to suspend the tank by straps placed at the extreme edge of a tank, then the construction in Fig. 4 is used, while normal strap suspension is shown in Fig. 10. The welding-in of castings is a satisfactory practice, even for main suspension points. The load can be taken internally through lugs or webs in the casting, and through stiffening plates to welded-in T-sections, by which means static or fatigue loads can be widely distributed (Fig. 6). As already mentioned in (d) above, external fittings and adaptors can be welded direct to the shell, and this will eliminate loose clamping rings and bolts, and, incidentally, the extra weight which they entail.

In the case of oil tanks incorporating hot well and diffuser, these units can be attached to the shell through welded-in T-sections, or to stiffening rings. It is often convenient to design the oil return connection as an "Elektron" casting, especially if located on a curved surface. The inside of the connection can thus be welded to the pipe leading to the diffuser, as shown in Fig. 8. One of the most satisfactory methods of suspension is by means of stranded steel wires with a PR rubber-hose covering bearing on special H-sections, as shown in Fig. 5. By this method of suspension a wide range of mounting tension can be obtained.

Profile tanks were among the first to be made in "Elektron" in this country. The weld seam can be hammered and fettled until a surface smoothness unobtainable with a riveted assembly is achieved. Leading-edge tanks constitute a typical example of mounting by extruded sections, welded to the skin and supported internally by suitable bracing or stiffeners. If a web or lug of a depth greater than that existing on the extrusion is required, an extension plate of similar gauge can be welded on. The seam, when hammered, has very nearly 100 per cent. of the strength of the plate, or may even be in excess of this figure, due to reinforcement by additional weld metal and subsequent hammering. (Fig. 7).

Leading-edge tanks must necessarily be of heavy gauge to take the air loads which occur on this part of a wing. Stiffeners of T or H section, pitched as close as 8 in. or 10 in., may also be required, but this presents little difficulty. The method of front-spar mounting may be through vertical webs, local lugs or horizontal channels. In each case the mounting members should be welded to the skin, or bolted to special welded-in mountings. If horizontal channels are used intersection weld seams will probably be necessary. This in itself need cause no trouble, but care should be taken to ensure that distortion on the final weld either cannot occur or can be accommodated.

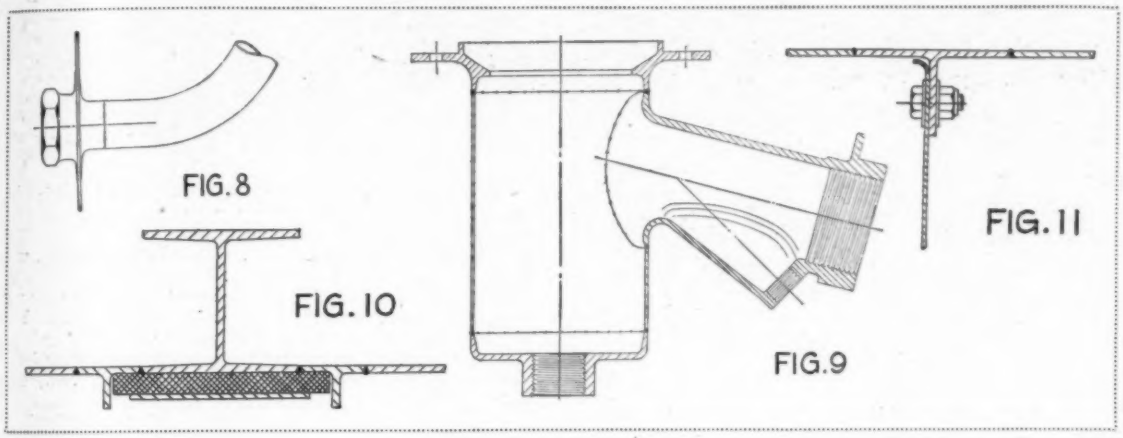
Mixed Construction

Economy in weight can be achieved in the case of sumps or filler casings by using a welded-up structure of sheet, castings and machined parts, thus eliminating the large wall thickness necessary with a complete casting (see Fig. 9).

As it is permissible to use a greater gauge thickness with "Elektron" than with other types of tank, closely pitched stiffeners are not necessary, even in the case of flat panels. For example, an 18 G square flat panel on a vertical tank face could be as large as 14in. square without danger of excess panting or fatigue failure, except when high test pressures apply. Contrary to the practice common to

riveted tanks, handholes tend to lessen the effect of panting, due to vibration, by breaking up a large surface. The gradual change of section obtained by welding-in the adaptor is more favourable to fatigue resistance than the riveted reinforcing ring and the sudden increase in section due to the ring.

There appears to be a tendency amongst designers to crowd out the inside of even small tanks with baffles, the function of which is usually given as a combination anti-surge device and stiffener. Fuel surging, in the case of small and medium-sized tanks, is an overrated factor. In the case of the old De Havilland Comet, which was sensitive enough fore and aft, the main petrol tanks are placed on and forward of the centre of gravity, have capacities of 130 and 110 gallons respectively, and contain no baffles or anti-surge device whatever. No trouble was experienced at any time due to fuel surging. Baffles are a common source of service trouble in any type of tank. Failure often occurs by cracking on the bend of a flange when it is directly riveted to the skin, or it may be due to work-hardening round a rivet head at attachment. Apart from this, they are often awkward to fit and they always increase cost and weight.



Fewer Baffles

If baffles are normally required for stiffness in aluminium tanks, then their number can be reduced in "Elektron" constructions made with a thicker shell. When baffles are needed in the plane of suspension straps in aluminium tanks, the best corresponding structure in "Elektron" is a welded-in extruded H-section as shown in Fig. 10, which gives a very stiff structure. When baffles are necessary, however, they can be attached as shown in Fig. 11 to the web of a welded-in T-section. It is better to use bolts for this purpose, as there is the possibility of damaging the sheet when closing a rivet in an inaccessible position.

The minimum thickness of sheet for "Elektron" tank shells may be taken as 18 G, and this can be used for most small- and medium-sized tanks having an initial test pressure of the order of 5lb. per sq. in. Even for capacities as great as 400 gallons, 18 G sheet can prove perfectly satisfactory, providing that the shell is suitably stiffened by extrusions, or if the shape affords sufficient rigidity. 16 G sheet should be used when extra stiffness is required, but it is rarely necessary to exceed this, except for profile or load-carrying tanks. Internal baffles are usually made from 20 G sheet, and diffuser and hot well units can be made from 20 G or even 22 G, depending upon the nature of the welds involved. 22 G sheet can take a good weld, unless the seam is complicated or inaccessible.

Although the calomel electrode potential differences between magnesium and practically all other constructional metals and alloys is greater than .25 volt, this factor does not appear to have serious effects except under abnormal conditions. For internal fittings of oil tanks, the presence of steel studs or bolts in "Elektron" will cause no trouble.

In petrol tanks the practice may be allowed if the steel is given a cadmium coating and assembled with an insulating paste, preferably having a zinc or barium chromate base. It is not advisable to locate steel studs in a pocket on the tank bottom, where water could be trapped.

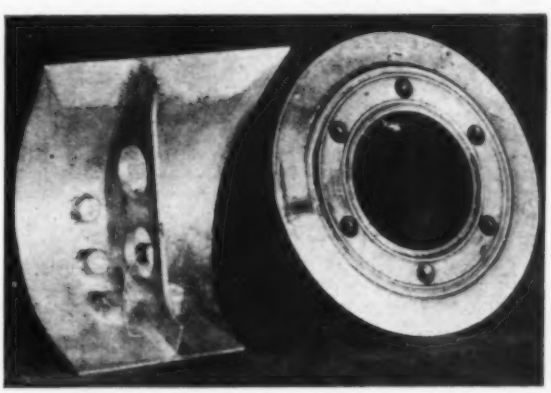
External steel or aluminium alloy studs may be fitted in "Elektron" adaptors with insulating paste, but it is always advisable, where possible, to use fittings screwing into, or bolting on to, "Elektron" adaptors, made in "Elektron," or otherwise in an aluminium magnesium alloy, such as MG7 or Birmabright. Identification markings should be either stencilled or transferred on the paint film or, if of metal, fixed by the normal method, not to the sheet direct, but to a welded-in adaptor.

All tanks should be finally treated with the standard cold acid chromate dip inside and out, and externally should receive two or three coats or an approved lacquer.

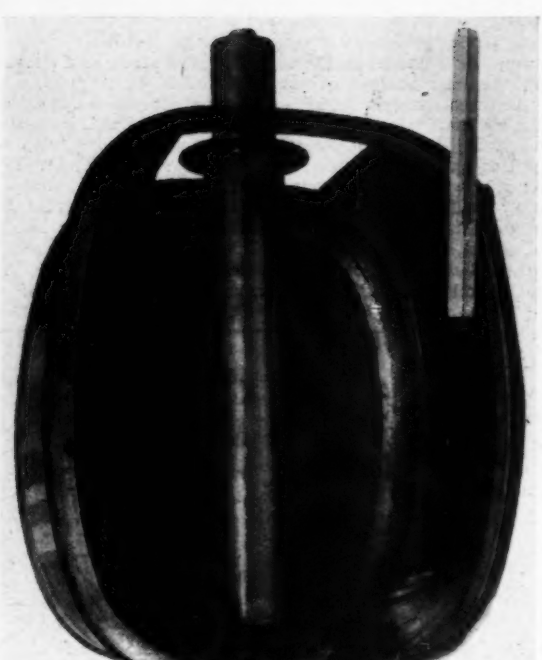
Resistance to Vibration

The aircraft designer will naturally want to know how tanks made of "Elektron" stand up to vibration in actual use. Some indication is given by official tests carried out last summer on an oil tank of 30.25 gallons total capacity and 26 gallons oil capacity. The tank was manufactured by Essex Aero, Ltd., and weighed, complete with filler cap, sump, dip-stick and filter, 12.4 lb. The tank shell was of DTD 118, and the extrusion stiffening rings were DTD 142. The tank, it might be mentioned, was of the same dimensions as the Alclad tank it was designed to replace, and the weight was 9.1 lb. less, a not inconsiderable saving for 26 gallons capacity.

Three sets of test were carried out. First four runs of 25 hours each with the tank filled $\frac{7}{8}$, $\frac{5}{8}$, $\frac{3}{8}$ and $\frac{1}{8}$ respectively. The 100 hours were completed successfully at an amplitude of 0.005in. and a frequency of 1,850 per minute. Another four runs of 25 hours, but with the amplitude



A cast-in stiffening corner web and a machined flange plate of an "Elektron" tank.



The inside of an "Elektron" tank can be made very neat, due to the absence of elaborate reinforcement.

A finished oil tank, made by Essex Aero, Ltd., in "Elektron" magnesium alloy.

increased to 0.01in. followed. These also were successful. In the third test, under the same conditions but with the amplitude raised to 0.02in., the forward side panel of the tank split after six hours. This forward panel was relatively flat, and a more domed panel would have been better. The thickness of the tank shell, by the way, was 18 G.

It will be seen that the tank stood up well to a very severe test, some 23 million reversals before failure. The standard test is 200 hours at amplitude 0.005in., and the official report stated that the tank could be considered very satisfactory from the strength point of view, and that failure in service was unlikely.

During the tests it was established that "panting" of the forward side panel was relatively large. At the worst spot it had an amplitude of 0.11in., which did not get much worse as the vibration amplitude was increased, and a more domed panel would, of course, have been stiffer. When the tank finally failed, the split was about 6in. long, and it passed through the welded finishing patch on that side.

AERODROME OWNERS FOREGATHER

War Difficulties of Civic Authorities : "Hold on" and "Keep Aerodromes Efficient," urges Lord Londonderry : More than 100 Last August

SOME fifty aerodrome operators assembled in London last Thursday for the annual dinner of the Aerodrome Owners' Association, presided over by the Rt. Hon. the Marquess of Londonderry, P.C., K.G., M.V.O.

Mr. J. G. Gilson (Air Ministry) in proposing the toast of "The Association" announced that the number of licensed aerodromes at the end of August, 1939, was 69, and approximately 50 for private use. War interrupted the progress of aerodrome development as well as many other aspects of civil aviation, but if slowed down the machine had not stopped. The completion of a standard of aerodrome charges was a necessity. He added that the A.O.A. had always attained unity of aim in aerodrome matters.

Every 25 Miles

Lord Londonderry in response said that no more loyal staff existed than those at the Air Ministry, who tried to advance civil aviation in this country. No set of people were in greater difficulty than those who own aerodromes. The civil authorities have rendered a patriotic service. Lord Mottistone once said that there should be aerodromes within 25 miles of each other everywhere. If more foresight had been displayed, there would have been more aerodromes to-day. Encouragement should have been stronger. The speaker urged that every big town should have had an aerodrome or at any rate a suitable landing ground, the Government sharing fifty-fifty in the costs. Had that been done we should be in a different position to-day. Although our greatest danger was gossip, he had heard of aerodromes going up where there is no water. He told the members of the A.O.A. that they must hold on and make representations to the Air Ministry as to what they can offer. He would prefer to see successful competition by air with all train services and it was necessary to develop a system of transport by air to give means of locomotion at a more rapid scale than we enjoy at the moment. The adventures that aerodrome owners had taken on were not received enthusiastically. Ratepayers were asking what is the use with nothing forthcoming. They had no answer, but he again urged "Hold on" as a policy for the A.O.A., but keep the aerodromes in a proper state of efficiency so that we can take up the march of progress. He paid tribute to the R.A.F. officers present, remarking that we had at any rate followed one correct doctrine in the expansion of the Air Force. He regarded the R.A.F. as better than any other in personnel, organisation, spirit, aircraft and engines. His happiest days were when he served in the Air Ministry.

Councillor J. Ure Primrose (in the uniform of a sergeant-major) proposed "The Guests," and Cdr. H. E. Perrin responded. The vote of thanks to the President, proposed by Mr. Whitney Straight, was enthusiastically received.

HERE and THERE

Thirty-five Miles High?

PROFESSOR PICCARD, of Brussels, and his collaborator, M. Cosyns, are going to Buenos Aires to co-operate with the Argentina Government in the forthcoming attempt to reach the stratosphere for the first time in the southern hemisphere. The balloon will carry two Argentinians, Major Olivera and Dr. Puig, and reports state that it is hoped that an altitude of 35 miles will be reached. We wonder!

Refinery at Fort Norman

AIRMEN flying in Canada's north-west territories will not have to pay such high fuel costs in future with the establishment some time this spring of an oil refinery at Fort Norman on the Mackenzie River, 1,200 miles north of Edmonton, Alta. The Fort Norman oil wells are the most northern in the Empire. Whereas formerly it cost $1.50 a gallon for aviation fuel in Canada's western sub-Arctic and Arctic, the new refinery will sell aviation petrol at 37 cents per gallon, plus tax, and fuel oil at 13 cents per gallon.

Newspaper Service to Paris

AN additional daily air service between London and Paris has been inaugurated for passengers and newspapers. Over 1,700 lb. of newspapers will be carried to reach Paris in time to be put aboard trains to Switzerland, Italy and the Balkans. These trains go through the French war zone forbidden to civil aircraft. Passenger accommodation on the London-Paris route, run jointly by Imperial Airways and Air France, has had to be increased lately. About 1,000 people left for Paris during the first three weeks of January.

American Instructors for Canada

IT is reported that American pilots are being engaged as instructors for Canadian flying schools. Presumably they are required for the Empire Training Scheme. Preference is being given to unmarried men with experience of the last war. Such a combination of inexperience and experience should indeed be rare, considering that the age of men who were in the previous trouble must be at least 42 now. And most instructors are more youthful than this. As they are not required to enrol in the armed forces of the Empire, nor to take any oath of allegiance to it, they can remain good Americans.

Loose Metal in Engines

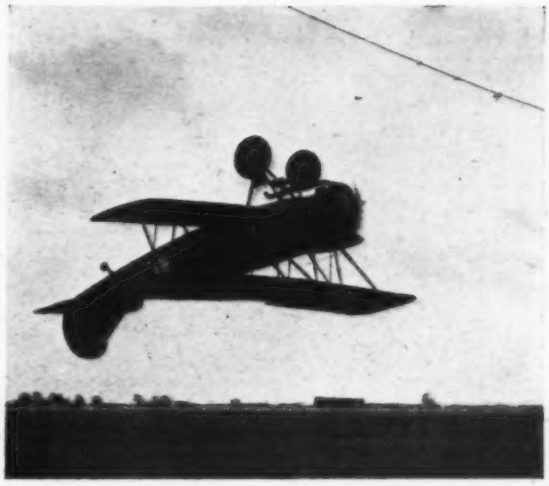
A DEVICE has been invented by one of the staff of K.L.M. for the purpose of giving warning of loose metallic objects in the lubricating systems of aero engines. It consists of a grating of metal rods, alternate ones of which are connected electrically so that the bridging of any two completes the circuit and lights a warning light on the pilot's dashboard. Small metal particles produced by normal engine wear pass through it. Such small pieces, of course, can be removed by the periodical draining, but the magnetised drain plug, advertisements for which appear in American magazines, is certainly a help in this direction.

Generosity

FOR many years the Council of the Royal Aeronautical Society has been concerned about raising adequate finances for an endowment fund which should provide an income sufficient for the upkeep of suitable headquarters and for running the Society on lines in keeping with its standing. The R.Ae.S. Endowment Fund was established some time ago, and but for promises of support, the new premises at No. 4, Hamilton Place, London, W.1, would not have been acquired.

It is not until now, however, that it has become possible to disclose how generously the aircraft and allied industries have responded. As a result of this generosity, the truly magnificent sum of £109,202 4s. 0d. has been promised (most of the contributions are in the form of seven-year donations, so that it will not be until 1946 that the full sum will be realised).

Space does not permit us to give the full list of donations, but we think the world should know that Mr. F. Handley Page and Mr. Oswald Short have each contributed £10,000. The next largest individual donations are from Mr. Robert Blackburn and Lord Kenilworth (£5,000), while Mr. W. C. Devereux is a good third with £3,000. Aircraft firms which have each contributed £5,250 are: Bristol, Fairey, Hawker Siddeley, Rolls Royce and Vickers-Armstrongs.



QUITE CRAZY, BUT IT DOES NEED ACCURATE FLYING. "Squeek" Burnett flies under the tape instead of breaking it at Miami. The tape was only 12ft. from the ground.

The Canadian Manufacturing Scheme

THE visit of the British Air Mission to Canada in 1938 is now bearing fruit. Designed on somewhat the same lines as the Australian Scheme to manufacture Bristol Beauforts, the Canadian factories will turn out Handley Page Hampdens. The general organisation is headed by Canadian Associated Aircraft, Ltd., a company which accepts contracts from the British Air Ministry for the type required. It then arranges for the manufacture of components by the seven associated aircraft companies by means of sub-contracts. After manufacture these parts are shipped to the assembly factories of Canadian Associated Aircraft, Ltd., for final assembly.

The two assembly plants are now nearing completion at St. Hubert, Que., and at Malton, Ont. They were commenced in July, 1939, and are duplicates. Offices and other services adjoin the one-storey assembly building, consisting of two bays of clear floor area each 130 × 263ft. Clear height is 28ft., and horizontally sliding doors are provided opening on to a concrete apron 125ft. wide. The adjoining building is 258 × 50ft.

The directors are: Messrs. P. F. Sise, president; L. J. Belnap, vice-president; G. R. Cottrelle, vice-president; V. M. Drury, Canadian Car and Foundry Co., Ltd.; J. E. Labelle, K.C., Canadian Vickers, Ltd.; R. J. Magor, National Steel Car Corporation, Ltd.; H. M Pasmore, Fairchild Aircraft, Ltd.; Redmond Quain, K.C., Ottawa Car and Aircraft, Ltd.; and W. J. Sanderson, Fleet Aircraft, Ltd.

Mr. L. C. Ord, a Canadian who has been in consulting engineering in Great Britain for some years and has been connected with the Directorate of Production of the Air Ministry, is general manager. Mr. L. A. Brooks is secretary.

FLIGHT

IDENTIFICATION CHARTS

THOUSANDS of the wall cards issued by *Flight* enabling ready identification of military aircraft are in use throughout the country. The R.A.F., A.A. spotters and the Services generally, use them extensively. The British chart embodies 90 drawings with notes upon the leading characteristics of the types depicted. The chart of German aircraft includes 72 drawings of the main types from various angles Incidentally, the drawings are copyright and may not be reproduced or re-copied without permission of the publishers in writing.

Each chart measures 22½ in. by 14½ in., and costs 1s., plus 6d. postage and packing on a single copy and 7d. on two copies.

SERVICE AVIATION

FASHION FROM FRANCE : What the well-dressed R.A.F. pilot is wearing around the aerodrome.

Awards

THE King has been graciously pleased to approve of the undermentioned awards in recognition of gallantry displayed in flying operations against the enemy:—

Awarded a Bar to the Distinguished Flying Cross.

F/O. (Acting Sqn. Ldr.) Kenneth Christopher Doran, D.F.C.

This officer was the leader of a formation of bomber aircraft which was attacked by enemy fighters over the North Sea during January. By his clever tactics and gallant leadership he successfully maintained a close defensive formation throughout the engagement.

Two of the fighter aircraft were compelled to break off the fight, a third was shot down in flames into the sea, and the remainder eventually abandoned the attack.

Although one of our aircraft was lost and a second had to return to its base, Sqn. Ldr. Doran, showing great determination, led the remaining aircraft 130 miles farther to his objective.

Awarded the Distinguished Flying Medal.

L.A/C. John Tippett.

This airman was the gunner of a formation of bomber aircraft which was attacked by enemy fighters over the North Sea in January. As the aircraft held a vulnerable position in the formation, L.A/C. Tippett's task was one of great danger and responsibility. Yet he showed great skill and coolness in handling his gun and consistently repelling the enemy attacks throughout the engagement.

Sqn. Ldr. Doran won his Distinguished Flying Cross for leading an attack on an enemy cruiser in September last. In face of heavy gunfire and under extremely bad weather conditions he pressed home a successful low attack with great determination.

His name appeared in the first list of decorations conferred on members of the Royal Air Force during the present war. He received the Cross from the hands of the King when His Majesty visited a Royal Air Force station in England on November 2nd.

W.A.A.F. Ranks

ANNOUNCEMENT has been made of a revision of rank titles in the Women's Auxiliary Air Force bringing them more into line with the R.A.F. The old and new titles with their corresponding ranks are:—

R.A.F.	W.A.A.F. OLD	W.A.A.F. NEW
Marshal ...	... Commandant in Chief	(same)
Air Comdre.	... Director of W.A.A.F.s	Air Commandant
Group Capt.	... Controller	Group/O.
Sqn. Ldr. ...	... Senior Commandant ...	Sqd./O.
Flt. Lt. ...	... Co. Cdr.	F/O.
F/O.	... Dep. Co. Cdr.	Sect./O.
P/O.	... Co. Asst.	Asst. Sect./O.
Flt. Sgt. ...	... Senior Ldr.	Senior Sgt.
Sgt.	... Section Ldr.	Sgt.
Cpl.	... Asst. Section Ldr. ...	Cpl.

London Allowances for Airmen's Families

THE Air Ministry announces that a London allowance of 6d. a day or 3s. 6d. a week is now paid to the families of all airmen receiving family allowances to whom married quarters are not allotted. The allowance is made to airmen's families resident in the London postal area regardless of the location of the airmen themselves. This allowance is also paid to "unmarried wives" who receive special dependants' allowances at family allowances rates. Where a special allowance in addition to family or special dependants' allowances has been awarded on the recommendation of the Military Services (Special Allowances) Advisory Committee, now the War Service Grant Advisory Committee, the extra cost of living in London has been taken into consideration. The gross amount paid to these families therefore remains unchanged.

The London allowance is being paid in conjunction with family allowances or special dependants' allowances direct to airmen's families. Payments are made retrospective from December 7, 1939, and arrears from that date will be paid as soon as practicable.

Royal Air Force Gazette

Royal Air Force

General Duties Branch.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation on the dates stated:—(Dec. 9, 1939) R. L. J. Fitch, W. D. Allies, I. M. Muir, T. McN. Ormiston, J. A. Walker, R. M. Curtis, W. H. Sloane, K. R. B. Ainsworth, R. P. Brayne, R. C. W. Broad, C. A. G. Clark, P. A. Clarke, M. B. Dawson, C. V. Fraser, G. F. Grant, G. H. Hackwood, G. L. Hickman, A. G. W. Hough, H. M. Jones, E. C. Lane-Sansam, D. F. M. MacKarness, J. Mansel-Lewis, J. G. Masters, J. F. M. Millar, P. H. G. Mitchell, P. Nixey, W. J. R. Redman, R. J. B. Roach, J. H. Steyn, E. Trumper, R. H. Werner, J. Benzie, D. R. W. Brooks, J. C. T. Downey, W. Gilmour, W. H. C. Hunkin, B. A. James, P. W. Peters, A. T. Wheatley; (Dec. 16, 1939) L. R. Darwen; (Dec. 27, 1939) H. W. Allinson, L. W. Collingridge, N. K. Stansfeld.

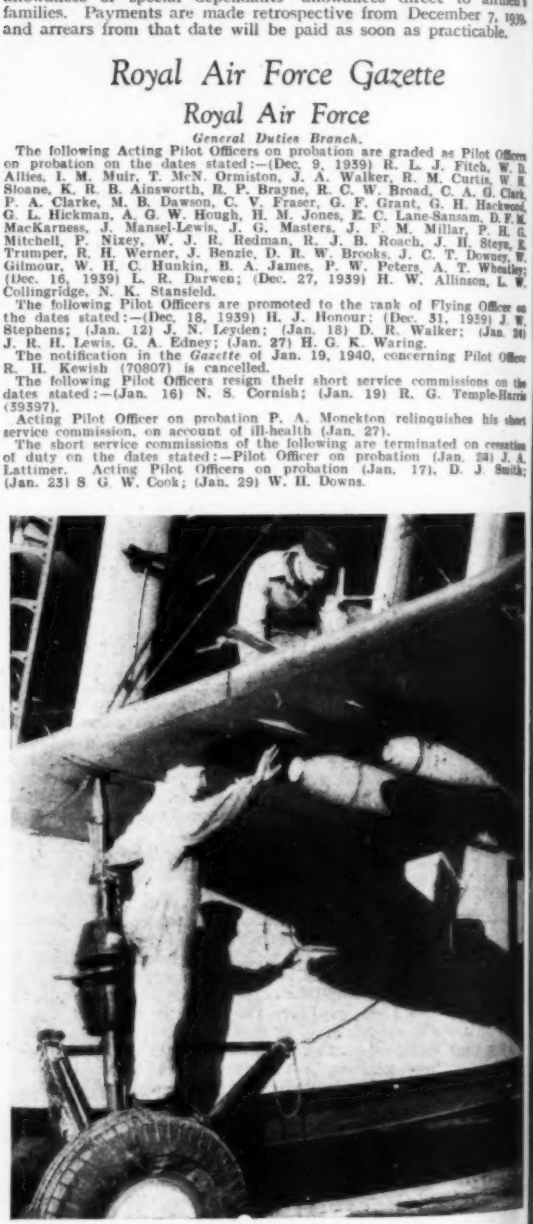
The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—(Dec. 18, 1939) H. J. Honour; (Dec. 31, 1939) J. W. Stephens; (Jan. 12) J. N. Leyden; (Jan. 18) D. R. Walker; (Jan. 24) J. R. H. Lewis, G. A. Edney; (Jan. 27) H. G. K. Waring.

The notification in the *Gazette* of Jan. 19, 1940, concerning Pilot Officer R. H. Kewish (70807) is cancelled.

The following Pilot Officers resign their short service commissions on the dates stated:—(Jan. 16) N. S. Cornish; (Jan. 19) R. G. Temple-Harris (39397).

Acting Pilot Officer on probation P. A. Monckton relinquishes his short service commission, on account of ill-health (Jan. 27).

The short service commissions of the following are terminated on cessation of duty on the dates stated:—Pilot Officer on probation (Jan. 24) J. A. Lattimer. Acting Pilot Officers on probation (Jan. 17), D. J. Smith; (Jan. 23) S. G. W. Cook; (Jan. 29) W. H. Downs.



CANADIAN-SCOTTISH : A Canadian-built Supermarine Stranraer flying boat being bombed-up at Halifax, Nova Scotia.

SERVICE AVIATION (CONTINUED)

FIRST OF THE CANUCKS: The officers of the first unit of the Royal Canadian Air Force chosen for active service overseas. They are equipped with Lysander II army co-operation aircraft. In the centre is the squadron leader W. D. Van Vliet, the commanding officer.

Equipment Branch.

G. E. de la Haye (33511) is granted a permanent commission as Pilot Officer on probation (Jan. 15).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—(Jan. 6) P. H. Stibbs; D. H. M. Graham, F. G. Metcalf; (Jan. 8) J. E. Watson, M.B.E.; W. R. McCleery, A.F.M.

Sqn. Ldr. V. J. B. Jacobs (R.A.F., Ret.) relinquishes at his own request the rank of Squadron Leader, whilst re-employed with the Royal Air Force, and is granted the rank of Flight Lieutenant (Nov. 1, 1939).

Medical Branch.

Group Capt. R. W. Ryan, M.B., B.S., is seconded for Special Duty (Jan. 15).

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS.

General Duties Branch.

The following are granted commissions in Class CC as Flight Lieutenants on the dates stated:—

(Sept. 4, 1939) Sqn. Ldr. A. J. Currie (R.A.F., Ret.).

(Sept. 14, 1939) Maj. K. W. Wilkins (R.A.R.O.).

F/O A. L. Brain is promoted to the rank of Flight Lieutenant (Sept. 3, 1939).

The following Squadron Leaders relinquish their commissions in cessation of duty on the dates stated:—(Dec. 10, 1939) H. J. Eastwood, M.C.; (Jan. 1) H. G. Rivett-Carnac.

The following Flight Lieutenants relinquish their commissions on completion of service on the dates stated:—(May 8, 1939) M. R. Edmondes; (Oct. 10, 1939) H. T. O. Windsor, M.C.

F/O E. P. Swallow relinquishes his commission on account of ill-health (Jan. 26).

The following relinquish their commissions in Class CC on appointment to commissions in the Royal Air Force Volunteer Reserve on the dates stated:—(Sept. 1, 1939) Flt. Lt. J. C. Cleugh; (Nov. 20, 1939) Flt. Lt. (Hon. Sqn. Ldr.) O. D. Freeman.

Equipment Branch.

Sqn. Ldr. A. Burtenshaw, O.B.E., M.C., relinquishes at his own request the rank of Squadron Leader while re-employed with the Royal Air Force, and is granted the rank of Flight Lieutenant (Nov. 1, 1939).

Royal Air Force Volunteer Reserve

General Duties Branch.

The following are granted commissions for the duration of hostilities in the ranks and on the dates stated:—Pilot Officers on probation:—(Nov. 18, 1939) G. G. Leeder, H. P. D. Sykes; (Nov. 20, 1939) J. Hills; (Dec. 1, 1939) (Sen. Nov. 6, 1939) Sgt. J. MacG. Talman; (Dec. 1, 1939) (Sen. Nov. 18, 1939) Sgt. R. S. Gilmour; (Dec. 10, 1939) L.A/C R. M. Smith; (Jan. 13) H. C. S. Hordern; (Jan. 14) J. E. D. Holder, R. C. Symondson; (Jan. 15) B. R. M. Freeman. Acting Pilot Officers on probation:—(Dec. 30, 1939) F. R. Arnold, M. H. Ross; (Jan. 13) E. S. Arnold, F. G. Baker, H. C. F. Barran, A. C. Black, G. S. Bliss, T. T. Davies, L. Duckworth, R. W. H. Echlin, A. G. F. Hobbs, J. S. Hobhouse, R. J. Lennox-French, A. D. L. Mackinnon, E. Pennington, J. D. Peterkin, B. L. A. Pusey, C. S. Pyne, E. A. M. Sack, A. T. Sword-Daniels, H. W. M. Wakeley, R. F. Walker; (Jan. 15) G. P. W. Austin, O. L. S. Philpot, L. B. R. Way, R. G. Whitehead.

Lt.-Col. N. S. Taylor (I.A., Ret.) is granted an honorary commission as Flight Lieutenant from Sept. 1, 1939, to Oct. 28, 1939 inclusive.

P/O C. McC. Henderson is transferred to the Administrative and Special Duties Branch in his present rank and seny. (Oct. 12, 1939).

The following relinquish their honorary commissions on cessation of duty on the dates stated:—Wing Commanders:—(Sept. 6, 1939) D. E. Robertson, C.B., D.S.O.; (Nov. 10, 1939) H. A. Joly de Lotbinière, M.C. Flight Lieutenants:—(Sept. 22, 1939) C. L. D. Tully, O.B.E.; (Oct. 29, 1939) B. de L. Brock, M.C., H. M. Hankin, G. N. Tomlin, C.M.G., M.V.O., J. C. Wauchope.

The commission of Acting Pilot Officer on probation J. A. Bellamy is terminated on cessation of duty (Jan. 29).

Administrative and Special Duties Branch.

The following are granted commissions in the ranks stated with effect from Sept. 1, 1939, and with seniority of the dates stated:—Squadron Leader.—(Feb. 1, 1939) Lt. Cdr. F. W. Wiseman-Clarke (R.N. Ret.). Flight Lieutenants.—(Oct. 15, 1934) Flt. Lt. W. Wheatley (R.A.F., Ret.); (Aug. 21, 1939) C. A. MacKenzie; (Sept. 1, 1939) Lt. J. C. Cleugh (R.A.R.O.).

F/O. O. D. Freeman is granted a commission as Flight Lieutenant with effect from Nov. 20, 1939, and with seniority of Aug. 30, 1939.

The following are granted commissions for the duration of hostilities as Pilot Officers on probation on the dates stated:—(Sept. 26, 1939) R. L. H. Laye; (Oct. 20, 1939) P. W. Donner, M.P.; (Nov. 4, 1939) S. P. F. Humphreys-Owen (substituted for notification in *Gazette* of Dec. 26, 1939); (Nov. 9, 1939) C. H. Hartley; (Nov. 20, 1939) J. P. I. Hall; (Dec. 1, 1939) W. C. Wilson, D.S.O., O.B.E., M.C.; (Dec. 7, 1939) N. Cave; (Dec. 10, 1939) P. D. Walters; (Dec. 11, 1939) H. H. Greig; (Dec. 20, 1939) D. Roberts; (Dec. 27, 1939) T. Davidson, H. W. Owen; (Dec. 30, 1939) F. W. Everill, E. W. Reynolds, D. Vale; (Dec. 31, 1939) B. M. J. Davis, D. L. Doyle, G. F. Goddard, F. J. Islip, N. S. McConnell, K. G. Withers; (Jan. 1) C. R. Barke, C.B.E., J. Cotter, Sir H. W. Hulse, Bart.; (Jan. 3) R. F. Durrant, R. Maine; (Jan. 4) The Hon. E. A. Akers-Douglas; (Jan. 8) F. M. M. Beerling, R. J. Gammon, D.F.C., C. G. Gass, M.C., G. W. Hodgkinson, M.C., W. A. Nayler, C. R. Smith, J. M. D. Symons; (Jan. 9) W. A. Mair, E. L. Ogilvy-Stuart, G. J. Owen, H. W. Paterson, A. E. W. Ward; (Jan. 10) J. F. R. Martin, C. G. Moore; (Jan. 11) J. H. W. Wilcox; (Jan. 13) I. A. Macdonald; (Jan. 23) R. W. Judge.

The following Pilot Officers on probation are confirmed in their appointments and promoted to the rank of Flying Officer on the dates stated:

NAVAL VERSATILITY: The Fairey Albacore which is being issued to Fleet Air Arm units for dive-bombing, torpedo-dropping, reconnaissance and spotting. Full deck-landing equipment is provided.

SERVICE AVIATION (CONTINUED)

(May 10, 1939) T. C. Morgan; (Aug. 31, 1939) J. A. G. Stuart; (Sept. 1, 1939) D. M. B. Pitt; (Sept. 7, 1939) G. E. Craggs, A. J. Harvey, W. T. Holloway, J. Kerr; (Sept. 8, 1939) F. R. Britton, D. H. Phillips; (Sept. 9, 1939) A. C. T. Isaac, C. Wise; (Sept. 10, 1939) R. A. Nunn; (Sept. 11, 1939) J. E. Povey; (Sept. 12, 1939) S. Brew, G. W. Shuter, V. L. Watson; (Sept. 13, 1939) E. N. Bullock, H. E. Smith; (Sept. 15, 1939) R. E. Stephens; (Nov. 1, 1939) H. R. Gardner; (Nov. 22, 1939) A. Lewin; (Dec. ", 1939) G. E. Hillman.

P/O. A. C. P. Seymour-Higgins resigns his commission (Jan. 16).

The commission of P/O. on probation T. A. Newman is terminated (Dec. 6, 1939).

Equipment Branch.

Maj. G. N. G. Monck-Mason, O.B.E. (77180) (I.A., Ret.) is granted a commission as Flight Lieutenant (Sept. 1, 1939).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated: (Dec. 21, 1939) G. M. Elloart, D.F.C.; (Jan. 5) R. G. Kingston, E. H. Proctor, E. A. Sadler; (Jan. 12) B. A. Taylor, P. H. Youngman; (Jan. 19) F. C. Emerson, F. H. Farthing, A. L. Godden, D. F. Hackett, H. D. Paterson, D. R. S. P. Quin; (Jan. 26) J. W. J. Bates, W. B. Paton, C. E. Polack, J. Smith, F. D. Wheeler.

Accountant Branch.

P/O. on probation E. R. Bosley (77086) resigns his commission (Dec. 10, 1939).

Medical Branch.

The following are granted commissions for the duration of hostilities in the ranks and on the dates stated: Flight Lieutenant.—(Jan. 9) T. L. P. Harries, M.B., Ch.B. Flying Officers.—(Sept. 6, 1939) H. T. Chilton, M.R.C.S., L.R.C.P.; (Jan. 2) J. Laurie, M.B., Ch.B.; (Jan. 9) J. Evans, B.Ch., M.R.C.S., L.R.C.P.

Dental Branch.

The following are granted commissions for the duration of hostilities as Flying Officers.—(Jan. 2) F. R. Barnett, L.D.S., G. E. Clarke, L.D.S., N. S. D. Evans, L.D.S., H. C. Killey, H.D.D., L.D.S., F. E. Padgett, L.D.S., D. Rhys-Jones, L.D.S., C. A. E. Tomes, L.D.S.

Meteorological Branch.

Acting Pilot Officer on probation J. L. Fowke is graded as Pilot Officer on probation (Nov. 20, 1939).

Chaplains Branch.

The Rev. G. B. Walkerley is granted a commission for the duration of hostilities with the relative rank of Squadron Leader (Jan. 18); the Rev. A. Attard is granted an honorary commission for the duration of hostilities with the relative rank of Squadron Leader (Jan. 18).

Legal Branch.

The following are granted commissions for the duration of hostilities as Flight Lieutenants on the dates stated: (Dec. 18, 1939) O. C. Barnett; (Jan. 10) D. A. Donall, LL.B., C. H. Duveen; (Jan. 15) W. Gorman, K.C.

Errata.

In the *Gazette* of Sept. 26, 1939, for Alan Karl Montagu-Beart read Alan Karl Montague-Beart.

In the *Gazette* of Oct. 3, 1939, for Cedwin Alan Reilly read Edwin Alan Reilly. For C. A. Ridley read Edward Dawson Ridley.

Auxiliary Air Force

General Duties Branch.

The following are transferred to the Administrative and Special Duties Branch in their present ranks and seniority:—(Aug. 29, 1939)—Flight Lieutenants: J. L. Jack, M.B.E., M.C., L. E. A. Healy, G. C. White, E. V. N. Bell, G. A. W. Garland, N. A. Copley-Smith. Flying Officers: P. R. Nickols, G. W. L. Darwin, J. D. St.C. Olliff-Lee, T. D. Craven, H. J. E. Smith, T. G. Waterlow, the Hon. C. J. F. Winn, A. C. J. Percy, H. Adams, G. R. A. Wilson, V. J. Kirkpatrick, I. H. Sagar, J. Reeves, R. E. C. Cadman, R. N. Birley, C. E. J. Dingle. Pilot Officers: R. C. Longsdon, R. J. Kilby, J. A. Killick, G. R. Thomson, C. A. Potter, J. S. N. Sewell (since promoted), A. H. Wood, R. T. Richards, W. Rathbone, G. N. England, T. A. Mason, R. M. Nisbet. Acting Pilot Officers on Probation: H. C. W. Miles (since promoted), R. Stone.

No. 504 (COUNTY OF NOTTINGHAM) SQUADRON.—The following Flying Officers are promoted to the rank of Flight Lieutenants on the dates stated:—(Sept. 3, 1939) G. Greaves, R. W. Harker, W. B. Royce; (Nov. 28, 1939) K. W. Gough.

No. 602 (CITY OF GLASGOW) SQUADRON.—F/O. R. F. Boyd is promoted to the rank of Flight Lieutenant (Sept. 3, 1939).

No. 605 (COUNTY OF WARWICK) SQUADRON.—F/O. J. M. Shewell is promoted to the rank of Flight Lieutenant (Sept. 3, 1939).

No. 610 (COUNTY OF CHESTER) SQUADRON.—F/O. A. T. Smith is promoted to the rank of Flight Lieutenant (Oct. 9, 1939).

No. 611 (WEST LANCASHIRE) SQUADRON.—F/O. W. J. Leather is promoted to the rank of Flight Lieutenant (Jan. 1).

No. 614 (COUNTY OF GLAMORGAN) SQUADRON.—F/O. P. Farr relinquishes his commission on account of medical unfitness (Jan. 18).

No. 903 (COUNTY OF LONDON) SQUADRON.—The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers:—(Sept. 3, 1939) R. S. L. Kail, E. F. Taylor, V. C. Hunfrey, L. F. Thurlow, L. T. Rye. (Substituted for notification in *Gazette* of Nov. 28, 1939.)

No. 906 (COUNTY OF MIDDLESEX) SQUADRON.—The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers:—(Sept. 3, 1939) R. H. James, G. E. T. Roberts, J. A. Nicholson. (Substituted for notification in *Gazette* of Nov. 28, 1939.)

No. 910 (COUNTY OF ESSEX) SQUADRON.—The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers:—(Sept. 3, 1939) G. B. Cuthbertson, J. E. Lloyd. (Substituted for notification in *Gazette* of Nov. 28, 1939.)

No. 911 (COUNTY OF WARWICK) SQUADRON.—Flt. Lt. R. Hooley relinquishes his commission on appointment to a commission in the Royal Engineers (Dec. 13, 1939).

Administrative and Special Duties Branch.

No. 504 (COUNTY OF NOTTINGHAM) SQUADRON.—F/O. G. W. L. Darvin is promoted to the rank of Flight Lieutenant (Sept. 3, 1939).

Equipment Branch.

Flt. Lt. W. E. Bridson resigns his commission (Dec. 31, 1939).

Accountant Branch.

F/O. E. J. Smart is transferred to the Administrative and Special Duties Branch (Nov. 22, 1939).

Erratum.

In the *Gazette* of Jan. 9. Notification concerning A.P/O. G. Frain and C. C. M. Watt. For Nov. 16, 1939, read Sept. 26, 1939.

Auxiliary Air Force Reserve of Officers

General Duties Branch.

F/O. J. F. C. Brinton is transferred to the Administrative and Special Duties Branch in his present rank and seniority (Sept. 2, 1939).

Accountant Branch.

P/O. C. R. Griffiths is promoted to the rank of Flying Officer (Aug. 31, 1939).

Women's Auxiliary Air Force

The following are appointed Assistant Section Officers on the dates stated:—(Jan. 24) Mrs. D. L. Anns, Lady H. A. Blunt, Lady D. Bowhill, Mrs. F. D. Deane, Mrs. A. M. Fellowes, Mrs. R. G. Hellard, Mrs. E. O. Hoy, Mrs. V. D. Jenks, Mrs. M. S. Lambie, Mrs. J. A. Shuldham-Legh, Mrs. E. L. E. Smith, Mrs. D. Stiven; (Feb. 1) Miss N. Campbell.

Assistant Section Officer Mrs. N. B. M. Pim resigns her appointment (Jan. 22).

Erratum.

In the *Gazette* of Dec. 1, 1939. Notification concerning Company Assistant Mrs. R. E. Macklin. For Nov. 15, 1939, read Dec. 1, 1939.

PRETTY AND FAST: It is reported from America that the British Air Ministry is displaying more than passing interest in this new Vultee Valiant single-seater fighter which is designed for a Pratt and Whitney Double Wasp engine with extension shaft. With the cockpit and cooling gills closed, and the undercarriage and tail wheel retracted, it is one of the most eyeable of modern single-seaters. Apparently there is an oil cooler beneath the cockpit.

THE INDUSTRY

Thermo-plastic Products, Ltd.

THE use of plastics for such purposes as fillets between mainplanes and fuselage; wing tips, spinners, ventilation scoops and a host of other non-stressed and lightly stressed parts has been studied very thoroughly by Thermo-Plastic Products, Ltd.

This concern has specialised in, and developed the necessary technique for, using black acetate sheeting to A.M. specification D.T.D 315 in lieu of metal. Since most of these jobs are worked in wooden moulds there is a distinct saving in cost apart from the conservation of metal supplies. The customary good finish associated with the use of plastics is, of course, maintained; in fact it is claimed that the superb finish on the spinners is so smooth that ice will not adhere and no further de-icing device is necessary.

Enquiries should be addressed to Thermo-Plastics, Ltd., 76-78, Golden Lane, London, E.C.1.

Volspray

VOLSPRAY, Ltd., have purchased the assets of Messrs. Kurt Erlach, Ltd., and will manufacture paint-spraying equipment of all types and particularly the "Volspray" Air Volume type.

The machines will be manufactured in the new works at 24, Tidal Basin Road, London, E.16, and prompt delivery can be given of all the standard types of air volume paint spraying machines, including the improved "Plastaspray" and their latest device the sand-spraying machine.

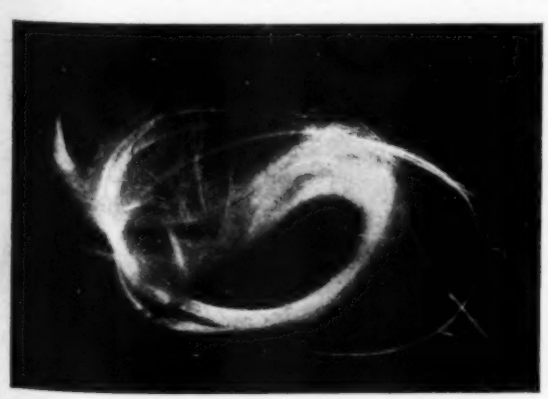
The original staff of Messrs. Kurt Erlach, Ltd., have also been taken over to ensure continuity in the high quality of manufacture and reliability of service.

Impervex-Glass

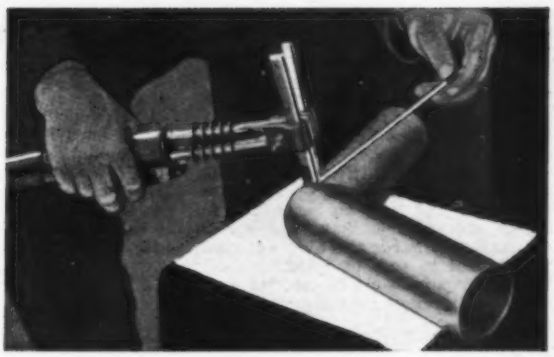
A VALUABLE addition to the growing range of non-perishing materials is Impervex-Glass, which is nothing more or less than a woven material made of 100 per cent. glass.

It is not, as one would expect, hard and brittle to the touch, but rather like very high quality artificial silk. The applications of this material are a thousandfold. It is waterproof, decorative, it has no structure to become de-naturised, and is immensely strong. At the moment Impervia are concentrating on the use of its non-perishing qualities by using it as a ply between layers of synthetic rubber for such purposes as petrol pump diaphragms, balloon fabric, or any other purpose where impermeability, strength and flexibility are essential qualities. As a strengthening agent in rubber hose the application is obvious because the rotting of canvas lining has always been a serious drawback.

Cloth, tape, cord, braid or any other form of woven material can be made. Particulars are to be had from Impervia, Ltd., 3, Grosvenor Gardens, S.W.1.



A hank of pure glass strands from which Impervex-Glass is woven.



The Fesa electric welding apparatus which can be operated from an ordinary lighting circuit.

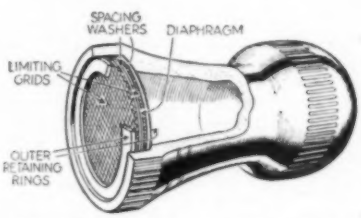
Aluminium Welding

THE welding of aluminium and its alloys has presented many difficulties since the early days of aluminium fuel tanks—one can remember a light aeroplane competition at Lympne when untold quantities of soap and partially masticated chewing gum were used in a series of vain attempts to stop leaks. Nowadays the process is more certain, especially spot welding, but this has the drawback of requiring expensive apparatus and special electrical installation.

The Fesa apparatus, of which particulars have been received, is of low initial cost and can be used from an ordinary lighting circuit. Briefly, the apparatus consists of two controlled semi-circular carbon electrodes (using 40 to 400 amps. at a pressure of about 8 volts), which are drawn down the seam it is desired to weld. The welding metal is supplied either by a lip turned up at the joint or by the customary wire of the same material.

The Fesa is suitable for welding aluminium and its alloys from 34 to 16 s.w.g. up to a rate of, roughly, 2½in. per min., and is extremely economical in that the maximum current required amounts only to 2.1 kW.

Finally, the apparatus is safe in semi-skilled hands, and protective blue glasses are unnecessary as no arc is formed. Petbow, Ltd., Station Estate, Balmoral Road, Watford, Herts, are the sole agents for the British Isles, and further enquiries should be addressed to them.



Mallock Armstrong ear drum defender.

Ear Defenders

FOR nearly a quarter of a century Mallock-Armstrong Ear Defenders have been doing their invaluable work of protecting ear drums from pressure waves.

They were first invented for use at the proving grounds for big guns and at once recognised as the ideal protection on the battlefield. From these beginnings the use of them has gradually spread to all places and conditions where high intensity pressure waves are set up.

Briefly, it is composed of a bakelite moulding which fits in the ear and carries at the outer end a goldbeaters skin diaphragm the vibrations of which are limited by pieces of very fine bronze gauze placed in close proximity on either side of it.

For any ordinary sound, high or low pitch, it merely acts as a relay and passes on, without any diminution, the vibrations to the human ear drum. If, however, the sound—or pressure waves—exceed a certain intensity, the diaphragm reaches the limit of its movement between the bronze gauzes and only a subdued noise is transmitted. From this it will be clear that it is impossible to suffer from deafness caused by such sounds as gunfire or engine noise because, since there has been no impact on the ear drums, normal hearing is restored immediately the excessive sound ceases.

Seven different sizes are available; the largest or smallest being very rarely required. They can be ordered through any chemist or direct from the Mallock-Armstrong Ear Defender Co., 39, Victoria Street, Westminster, London, S.W.1. The price is 5s. per pair complete in case with cleaner.

Bloctube Controls

AS the output of aero engines increases so the need becomes more and more urgent for controls which will give instant response, smooth movement and at the same time have no backlash. It is to this end that Bloctube controls have been designed.

The controls comprise throttle box, mixture locking box, countershaft levers, guides and connecting rods, at the ends of which are ball-ends and special ball

THE INDUSTRY (CONTINUED)

joints. The controls work by a push-pull movement of the tubes.

A feature is that the ball ends are not off-set on the levers but are made integral with them. The special joints, which are fixed to the tubes, are interchangeable and have no backlash. An added advantage is that they can be dismantled by hand; this allows of rapid replacement in case of necessity. For instance, repairs could be made in flight should a bullet carry away one of the tubes.

The throttle box is fitted with quadrants and adjustable stops, these latter having handles to lock or release them. There can be no overloading of the throttle lever, owing to the fact that there is no connection between it and the mixture lever.

Bloctube controls are in use on many types of British aircraft. One famous type is the Vickers Wellington which, with all the details that make up the whole machine, has proved itself over and over again in service.

B.B.L. and A.R.P.

MOST firms, companies, corporations and other bodies throughout the country have, in addition to the material protection of their premises, some portion of the staff detailed in greater or lesser degree for A.R.P. duties.

Though the cost of some of these efforts has been considerable and their upkeep proportionately high, an expense indeed far and away above anything, fortunately, yet justified, there would appear to be no relaxation, that is, if what is being done by Brown Brothers, Ltd., of Great Eastern Street, London, is any criterion. In the case of a bad air raid such an organisation as is here briefly described would be of incalculable assistance in ensuring the safety of a considerable staff, not to mention the property.

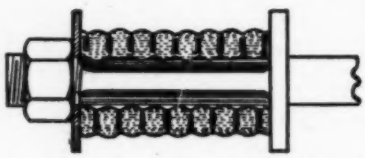
So large a concern as this, naturally, entails a numerous personnel in A.R.P. workers in order to fit in the duties and to give fully adequate service in case of need. However, a sufficient number of suitable and reliable men were quickly forthcoming.

This selected body of men, under the captaincy of Mr. W. G. Pavitt, joint general manager at Great Eastern Street, has been given a period of intensive training by experts which has not only fitted them for their individual allotted duties, but which also enables the majority of them to take over another's duties immediately should urgent need arise.

Lest it should be thought that they are having a "fine time" in the generally accepted meaning of the word, it should be noted that their A.R.P. duties extend to no less than 72 hours each week, with spells for meals and sleep, whilst outside these hours they are given "refresher" lectures and drill—varying from first-aid and fire drill to dealing with incendiary bombs.

Nevertheless, the company has done all in its power to make the men comfortable and their quarters pleasant. A large department in the new building has been evacuated, and here bedsteads with Li-lo beds and an adequate supply of blankets, tables, chairs, radio, games and so forth have been installed. All meals—early morning tea, breakfast, dinner, tea and supper—are supplied at the company's expense from its own canteen on the premises.

The men have been equipped with a full uniform, comprising a decontamination suit and gloves, "tin-hat," Service-type respirator and rubber knee boots. Appliances of every description calculated to assist them in their work are disposed at various points throughout the whole of the buildings, and plans of every floor have been issued showing where they are to be found.



A spiral spring is incorporated in the Oscillith rubber bush.

Apart from the specialised training given each man, he is also issued typed instructions giving a complete outline of what is expected of him, his times and duties covering every possible eventuality.

Oscillith

INCORPORATION of rubber bushes is now accepted engineering practice; more and more use being made of them in bearings where only a limited range of movement is required.

The "Oscillith" bush differs from other types by having a spiral spring incorporated in a casing of rubber, the effect of which is to control the deformation when the end plates are tightened.

When axial pressure is applied volute flanges, both internally and externally, are formed without any variation of its volume and, also, without any trace of permanent deformation.

Various qualities of rubber, allied to springs of varying rigidity, enable joints to be produced, giving differing degrees of flexibility suitable for numerous applications By using a hard rubber higher mechanical resistances are obtained, but at the expense of radial flexibility. With a very soft rubber, on the other hand, the mechanical resistance is less, but the amount of torsional flexibility is increased. A total angle of oscillation of 120 deg. has been obtained by the use of extra soft rubber.

Obviously the life of any bearing is dependent on the working conditions. With "Oscillith" bushes working through an angle of 90 deg. the frequency may be in the region of 200 oscillations a minute; with smaller angles it can be a great deal higher. For instance, at 30 degrees as many as 600 oscillations per minute is a safe load, and this figure rises to 1,000 if the movement does not exceed 15 degrees.

Among the many applications of these bushes are its use in flexible couplings, bearings of joints, anti-vibration mountings for instrument panels and engine mountings. The sole agents in this country are Wilmot-Breeden, Ltd., Eastern Works, Camden Street, Birmingham, 1, and their technical department will supply all the necessary information.

Number Changed

General Aircraft, Ltd., The London Air Park, Feltham, Middlesex, have changed their telephone number to Feltham 3636. They have twelve lines.

NEW COMPANY

BIRKETT AND ALLEN, LTD.—Private company. Registered January 12. Capital £5,000 in £1 shares. Objects: To acquire the business of general engineer carried on by H. Carline as the Premier Manufacturing Co., 237 Acton Lane, W.3, and to carry on the business of pattern and model makers, engine and machinery manufacturers. Directors: George Birkett, 58, Stafford Court, Kensington, W., and Brian S. Allen, 60, Clarendon Road, Ashford, Middlesex.

RECENT PATENT SPECIFICATIONS

(*Published January* 11, 1940.)

1938.

7154. SANGAMO WESTON, LTD., GILLIVER, G., and TAGG, G. F. Indicating instruments for use on aeroplanes or the like (515,733).

7596. GREEN, M. Apparatus for detecting or detecting and preventing ice formation (515,782).

8536. READ, J.R. Two-speed transmission drive, particularly for aircraft engine superchargers (515,686).

15554. MILLWARD, H. Gun and like sights (515,884).

15648. WARD, J. C. Aeroplanes (515,690).

17229. TELEFUNKEN GES. FUR DRAHTLOSE TELEGRAPHIE. Aerial systems for wireless receivers (515,720).

17550. SIEMENS APPARATE UND MASCHINEN GES. Electrical follow-up devices for the automatic control of aircraft (515,802).

17614. MESNARD, G. Projectiles (515,849).

22163. UNITED AIRCRAFT CORPORATION. Screw propeller, and method of making the same (515,777).

(*Published January* 18, 1940.)

1935.

18939. FAIREY AVIATION CO., LTD., and VOSS, E. Mounting of guns and sights on mobile and fixed carriers (515,991).

1936.

8732. BOULTON PAUL AIRCRAFT, LTD., and NORTH, J. D. Form of gun mounting for aircraft (515,992).

9142. BLACKBURN AIRCRAFT, LTD., PETTY, G. E., and MILLS, A. E. Mounting of guns and other similarly mounted instruments, more particularly those used in aircraft (515,993).

1938.

8533. NEWTON, F., NEWTON BROS. (DERBY), LTD., ROTOL AIRSCREWS, LTD., and ROLLS-ROYCE, LTD. Synchronising and speed-control devices (515,934).

17907. MARTINDALE, A. F. Brakes for vehicles (515,958).

18051. CESKOSLOVENSKA ZBROJOVKA ACKIOVA SPOLENOST BRNO. Apparatus for determining the velocity of a target, especially aircraft (515,972).

18076. DORNIER-WERKE GES. and DORNIER, C. Two-motored aircraft having tractor and pusher airscrews (516,013).

1938.

18347. MILES EQUIPMENT CO., LTD., and LETHERN, A. A. Safety apparatus for retaining persons in the seats of aircraft or other vehicles (516,129).

18480. MARCONI'S WIRELESS TELEGRAPH CO., LTD., and WITT, B. J. Navigation-aiding radio transmitters (516,149).

23455. SOC. FRANCAISE HISPANO-SUIZA. Engine driven vehicles, especially aircraft, having radiators for cooling the engines thereof (516,099).

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1938.

13169. PHILLIPS & POWIS AIRCRAFT, LTD., and MILES, F. G. Control and operation of wing flaps of aircraft (516,720).

18962. SAGEB SOC. ANON. DE GESTIONELT D'EXPLOITATION DE BREVETS. Projectiles comprising a reaction propulsion device (516,818).

20003. VICKERS (AVIATION), LTD., and HARE, M. Landing-wheels for aircraft (516,738).

20617. BROWN, F. V., and AIRCRAFTINGS, LTD. Cocks or valves (516,886).

20679. BROWN, D. Manufacture of bomb noses and similar parts of ammunition projectiles and of bombs and similar metal bodies (516,895).

1939.

21871. SPERRY GYROSCOPE CO., INC. Automatic pilots for aircraft (516,763).